ENGINEERING NEWS

THE project of building a canal on the Canadian side of the Saint Mary's River has met with some opposition on account of the estimated cost of the work, it being nearly three million dollars. The success of the Sault Ste. Marie canal should warrant the Government in pushing the plan forward, especially as the increasing volume of the Canadian lake traffic will soon make such a waterway necessary.

In 1887 the Sault Ste. Marie canal tonnage both ways was 5,494,649 tons, which exceeds the tonnage east from Chicago on eight railways. According to Gen. O. M. POE the average journey was 811.4 miles, making the total traffic equivalent to 4,458,544,804 tons transported one mile. The total of freight and terminal charges was $10,075,153.13, making the average freight per ton per mile a little less than ¼ ct. Railway freights averaged, in 1887, almost exactly one cent per ton per mile. Allowing for the lower grade of freight shipped by water, Gen. POE figures that the railway charges would have been at least three times the cost by water; or, there was a saving of more than $30,000,000 on this freight alone, which was less than half the total lake traffic. This sum is ten times the cost of the canal, and while we think the estimate is somewhat exaggerated, yet it is evident that from a financial point of view the scheme is more than justified.

THE project of uniting the Sea of Azov with the Black Sea is being revived. It is understood that a company, working with French capital amounting to $17,000,000, is only waiting for the sanction of the Russian Government to commence operations. The canal will be 72 miles long and will take four or five years to construct. The Duke of Leuchtenberg is at the head of the undertaking. It has been stipulated that for the construction, working, and administration of the canal only Russians shall be employed, though French engineers will direct the works. The canal will specially benefit the southeastern border districts, which produce grain, salt, minerals and fuel in abundance.

THE chief purpose of Mr. BENJAMIN BAKER'S visit to this country is to submit plans for a ship railway across the isthmus of Chignecto, in Nova Scotia, to the Minister of Public Works of Canada. They are stated by Mr. BAKER to have met with his entire approval, and Mr. BAKER returned last week to report to the syndicate of English capitalists who are backing the scheme. The work, on this railway, it is stated, is likely to be commenced at once and to be finished within two years' time. The total outlay will be $5,000,000, all of which has already been subscribed, the Canadian Government guaranteeing in return an annual dividend of $175,000. The railway will be 17 miles long, and, owing to the heavy tide in the bay of Fundy, which rises at times as high as 70 ft. ships will have to be raised 42 ft. by hydraulic pressure. The largest vessel that will be able to cross will be 2,500 tons burden. The proposed Tehuantepec ship railway will endeavor to carry ships of 4,000 tons burden, but they will have to be raised only 14 ft. This Canadian road is expected to be of much benefit to the marine traffic between the Gulf of St. Lawrence and American ports, saving 600 miles of ocean travel.

THE average tonnage of ships passing through the Suez canal has increased from 1,000 tons in 1871 to over 1,750 in 1887. Out of 3,137 vessels passing through last year 2,230 were English and only 3 American. *The Engineer* well says: "This table also indicates the depth to which the once great merchant navy of the United States has sunk, to find that only three voyages were made in the year by its ships through this great waterway."

About two weeks since the London and North-Western Railway officials made an experiment as to drawing canal boats with a locomotive. A track of 18 in. gauge, and about a mile in length, had been laid along the canal bank. On it was placed a small locomotive. When steam was up two boats were attached by ropes to the locomotive, which drew them along easily at the rate of seven miles an hour. Four boats were then attached, and the same speed was attained, the engine working very smoothly. The experiment was deemed successful, and if it was in fact successful, it is difficult to see why the same thing could not be done on a much larger scale on the Erie canal.

Orders have been given for the construction of several engines of a small pattern to run on sets of rails to be laid alongside this canal, the rails being laid 18 ins. apart. The engine drew eight laden boats at the rate of four miles an hour.

THE line of VAN DEPOELE electric railway now in operation between the towns of Ansonia, Derby and Birmingham, Conn. is working well, and a number of cars were recently added to the equipment. The current is conveyed along the line by means of a single copper wire suspended directly over the center of the line, at a height of about 18 ft. from the rail. A "traveller" transmits the electricity from the overhead wire to the car. This traveller consists of a deeply grooved wheel arranged to run on the over-head wire, and connected by a suitable wire to the motor in the car. The motors used are 15 H.P. and the electricity is furnished by an 80 H. P. dynamo located at a central station. The average speed is 12 miles per hour, but a greater speed can easily be attained on ordinary grades. The same system has been in successful operation in Scranton, Pa., for more than a year.

IT is reported that the Edison Electric company has offered terms of consolidation with the Westinghouse Electric company of Pittsburg. The terms, it is alleged, are not as yet quite satisfactory to the Westinghouse company, but that the consolidation of the contending corporations will be speedily effected appears probable.

ACCORDING to the last reports of the Board of Trade, only 54 per cent. of the passenger engines and 59 per cent. of the coaches in England were fitted with automatic train brakes of any kind at the beginning of the present year, 39 per cent. of the engines and 31 per cent. of the coaches being still fitted with non-automatic brakes only, and 7 per cent. and 10 per cent. respectively without any train brakes. The automatic brakes are nearly equally divided between the Westinghouse and the various vacuum brakes. On the other hand, in this country, practically all passenger trains in general service have automatic brakes, and with the exception of a trifling percentage, all have brakes of one type

THE most serious railway accident of the week was a head collision June 4 between two freight trains on the New York, New Haven & Hartford road near Willimantic, Conn. One man was killed and another seriously injured. The accident was caused by the carelessness of the train dispatcher at New Haven, who started the two trains from Willimantic to New Haven and New Haven to Willimantic.——On May 30 a serious head collision occurred near Bordeaux, Wyo., on the Cheyenne & Northern branch of the Union Pacific. A construction train had been sent out to repair the track at a washout, and the engine of a passenger train was sent from Bordeaux to see if the train could pass over, when it collided with the construction train which was returning at high speed. Three men were killed, and six injured, two of them fatally. The accident was due to both engine and train running wild.

ON May 27, a heavy windstorm blew down several bents of the trestle approach to the Chicago, Burlington & Quincy Railroad bridge at Nebraska City, Neb.——On May 29, a trestle on the Columbus & Western Railroad, near Opelika, Ala., gave way. A train had started to cross the trestle, but the engineer felt the structure shake and backed off just before it fell.

DURING the week washouts have occurred on railways in Virginia and floods have caused some damage to the crops.——On June 3 the town of Evansville, Ark., was nearly destroyed by a gale.——On June 2 a cyclone and hailstorm caused much damage in North Carolina. The track of the cyclone was about 25 miles long and 500 yds. wide.

A SERIOUS bridge accident occurred June 4 on the Mexican Central Railway about 25 miles from Tampico. A construction train consisting of 7 flat cars and a caboose containing 60 laborers, was running backward, the caboose being the last car, and was approaching a bridge 45 ft. long and 12 ft. high, when it ran into a cow standing on the track and was derailed. The cars broke through the bridge and the entire train went down, with the engine and tender on top. According to report 13 persons were killed and 41 injured, 24 of them seriously. The survivors attribute the accident to the fact that the engineer and conductor were drunk and ignored the frantic warnings of the laborers.

IT is stated in Montgomery that the East Tennessee Railroad in connection with the Cincinnati Selma & Mobile and the Mobile & Birmingham will at an early date put in the block system of signals between the points where all three roads use one track. It will require only three towers to cover the line, the distance being but fourteen miles. The towers will be located at each terminal point, Selma and Marion Junction, with one between the two. The system is now in vogue on only one road in the South, the Georgia Pacific road between Atlanta and Austell, where the track is used also by the E. T., V. & G. Company.

A CHANGE in the plan of the Canadian Pacific terminal station at Montreal, which was illustrated and described in our issue of Mar. 3, 1888, has recently been made. The tower is to be 152 ft. high, and will carry a large clock. The building itself will be 200 ft. by 80 ft. and five stories high. The trains will run into a shed, covered by an iron roof and heated by steam. The walls are now up to 32 ft. and it is hoped that the building will be ready for the roof in another month.

Work on the viaduct is progressing rapidly; twelve of the spans, having arches 20 ft. wide and 22 ft. high, are now finished. Thirty of these spans were to be constructed, according to the original plan, but it is probable that 40 more will be added. It is almost certain that trains will be run over it by Dec. 1. The contractors are Mr. REID and Messrs. DAVIS & SONS, and the architect is BRUCE PRICE of New York.

WORK on the depression of the New York & Harlem Railroad tracks has been begun by the Company's employés, and active work by contractors will soon be started. As we have previously stated, the track is to be sunk between a point 500 ft. north of 138th Street, and a point 2,000 ft. north of Bedford Park station, a distance of a little more than 4½ miles. The excavation is to be 54 ft. wide, and will accommodate four tracks. About one-quarter of the work will be through rock. For street and road crossings 23 bridges will be necessary. The western half of the excavation, and the enclosing wall will be finished and two tracks laid, and then the eastern part completed. The estimated cost of the work is $2,000,000.

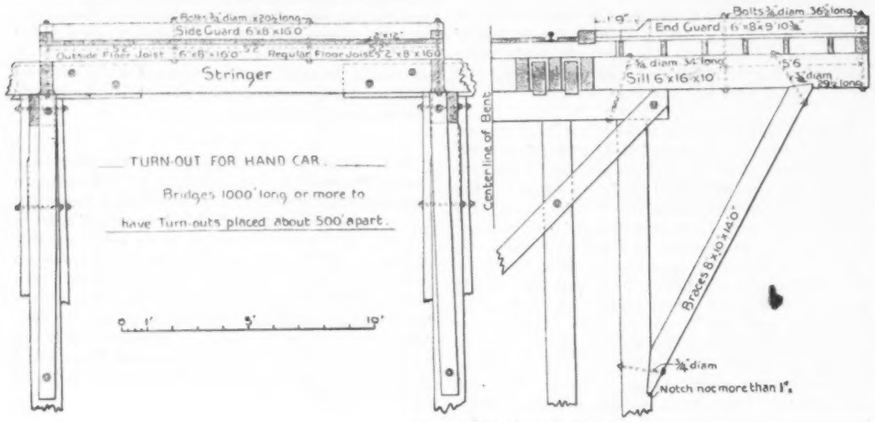
The work of four-tracking the New York, New Haven & Hartford Railway is also progressing actively.

THE Louisville and Nashville is trying a device for announcing in the cars the names of stations upon arrival. It consists substantially of a breadth of canvas, the ends brought together to make an endless belt, moving vertically on two rollers. On the canvas is painted the names of the stations and the whole is inclosed in a handsome walnut case 2 ft. high, 18 ins. wide and 6 ins. deep. Through a narrow, glass-covered aperture in the front may be seen the names of the stations as they successively move into view. When a station is reached, the stop which prevents the movement of the cylinders is withdrawn by a simple device, and the cylinders, bring to view the name of the station reached; at the same time a small gong attached for the purpose is rung to attract attention.

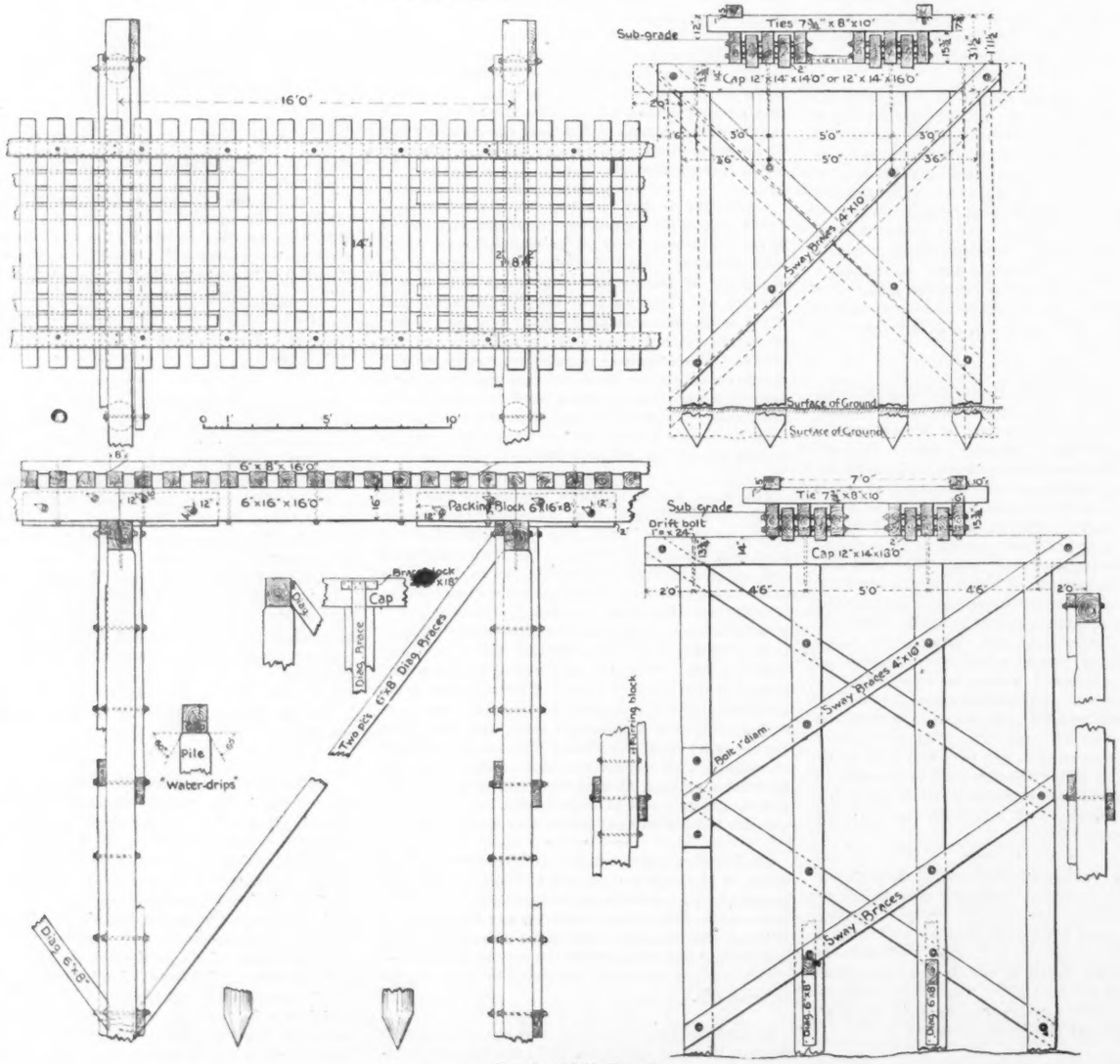
AN item is going the rounds of the newspapers stating that the rate paid for surveying by the National Government is so small that nobody will do work in Oregon for it, and much land that settlers would gladly take lies unsurveyed.

Standard Trestle Plans, C. B. & N. R. R.

We continue from our issues of April 7, May 5, and others succeeding, our illustrations of the standard trestle plans of the Chicago Burlington & Northern Railroad with cuts of the hand car turn-out and the standard trestle plan. A general account of the details of construction of all these trestles was given in Mr. ROBINSON'S paper in our issue of April 7.


Stringer
TURN-OUT FOR HAND CAR.
Bridges 1000' long or more to have Turn-outs placed about 500' apart.
End Guard 6"x8"x9'10"
Sill 6"x16"x10'
Braces 8"x10"x14'0"
Notch not more than 1".

Turn-Out for Hand Car.



Standard Pile Trestle.

STANDARD TRESTLE PLANS, CHICAGO, BURLINGTON & NORTHERN RAILROAD—A. F. ROBINSON, Bridge Engineer.

The drawings of the hand-car turn-out explain themselves completely. They show a detail which is too frequently omitted from long trestles, and at the cost of many lives. From trestles on long tangents it might perhaps be omitted, but even there not safely, since in fogs and snowstorms only a little of the track can be seen in any alignment. The cost is a mere trifle, and the turnouts would surely save enough time of trainmen to pay interest on their cost, not to speak of the demands of humanity.

Most of the details of the pile trestle are the same as for other trestles and have been shown in preceding issues as above. We have omitted from our drawings for the sake of clearness, many notes giving specific instructions as to every detail of construction, some of the more important of which are these:

Generally where banks are 12 ft. high or more the arrangements of diagonal braces shall be as follows:

Bridges with less than 10 spans, no braces unless there is danger of banks slipping, in which case diagonals will be put in second and third spans from ends. Bridges with 10 or more spans shall have diagonals in second and third spans from ends. In no case shall there be more than 10 intermediate spans without diagonals.

Diagonal systems must always start at caps, never at lower ends of piles; this leaves beginning and end of each system at stringers.

The threads of all bolts must be checked (with center punch or half round cold chisel) close to face of nut when same is screwed home.

Where bridge is on a curve, the elevation of outer rail must be made in cutting the piles under caps.

The engineer or inspector in charge will give cuts for piles in each bent of bridge.

Ties must be so spaced that guard rail bolts will always miss the caps. If necessary make one space to second tie instead of the third. Splices of guard rails must always be over ties and at each splice 2 boat spikes ¾ ins. square by 10 ins. long are to be used.

Guard rail bolts must have nuts countersunk, top of nut being flush with top of guard rail. Bolts must then be cut off close to tops of nuts. Wrought stamped washers 2 ins. diameter, ⅛ in. thick to be used under each nut. Cast ogee washers over heads of bolts.

Notching into piles to make sway brace bolts long enough will not be allowed. All bolts must have at least ⅛-in. projecting through nuts. Threads of all bolts must be checked with chisel after nut is screwed home.

Drift bolts, 1 in. sq. by 24 ins. long. Head large enough to draw bolts. Sway brace bolts, 1 in. diameter, lengths varying. Thread, 4 ins. long. Over run always 1 in. in billing bolts.

Guard rail bolts, ¾ in. diameter by 29¾ ins. long, under head to end. Cast ogee washer at lower end, and wrought stamped washer, ⅛ in. thick, at upper end.

Notches in piles must not be more than ¼ in. deep.

All sizing cuts on stringers to be 12 ins. long, and made with an adze or draw knife.

After track has been laid across bridge some rail joints will probably come over ties which are not fastened with guard rail bolts. Wherever this occurs the general foreman shall have one boat spike, ½ in. sq. by 12 ins., driven through tie and into stringer (inner strand).

If top of tie is over 16 ft. and less than 18 ft. above ground, use 12 ins. by 14 ins. by 16 ft. caps and place outer piles 3 ft 6 ins. from center piles. Bents, 8 ft. high, or more, to be sway braced.

Height of bent is always measured from base of rail.

With this we conclude our engravings of the Burlington & Northern trestle plans, which we think will be generally admitted to have many excellent features. Opinions as to details will differ, but in the main they have been very thoroughly worked out, and we may add, admirably presented in working drawings.

The Beck Gas Engine.

The Beck gas engine, made by the Beck Gas Engine Co., of London, has been subjected to an exhaustive series of tests by Prof. KENNEDY, and shows a very high mechanical efficiency and marked economy of fuel. We abstract from *The Engineer* a few of the results obtained from these experiments.

The Beck engine is constructed on the three cycle system; that is, when running normally there is one explosion to every three revolutions, and it takes in and discharges a scavenger charge of air before drawing in its charge of the explosive mixture. A throttling governor regulates the supply of gas and thus dilutes the explosive mixture, but does not cut out any explosions unless the speed is very greatly reduced. This governor is an important and novel feature of the engine, and its use is said to make the machine efficient and economical at all speeds. If it is desired to change the average speed of the engine, it can be done by simply readjusting a counterweight on a lever arm while the engine is running. The engine tested was rated at 4 H. P., but the brake horse-power developed in the test ranged from 4.8 to 6.5, and the indicated horse-power from 6.1 to 8. The consumption of gas ranged from 36 cu. ft. per hour when the engine was running very slow and light to 150 cu. ft. when the maximum work was being done.

Two experiments made with the governor adjusted for the highest speed gave a net indicated horse-power of 7.2 at 212 revolutions per minute, and 6.51 at 206 revolutions, and a corresponding brake horse power of 6.31 and 5.71. This gives a mechanical efficiency of 87.3 per cent. and 87.7 per cent. The mean consumption of gas per brake horse power per hour was 27.47 cu. ft. The mean cylinder pressure was 65 lbs. per sq. in.

With the governor adjusted for three-fourths full speed, a higher efficiency was obtained. At 163 2 revolutions per minute, with mean cylinder pressure 74.61 lbs. per sq. in,, the indicated horse power was 6.42, the brake horse power 5.85, mechanical efficiency 90.8, and gas consumption per brake horse power per hour 26.10. This was the most economical trial and the explosive mixture in this case was most dilute, being 1 to 31 by weight. The duration of each experiment was from one to 2½ hours. The initial pressure approached 200 lbs. per sq. in. The mean of all the principal experiments with a variation of speed of 30 per cent., gave 26.79 cu. ft. of gas per hour per brake horse power.

London gas rich in hydrogen was used, its calorific value being 21,480 heat units per lb., 1 lb. equaling 33.15 cu. ft. at 32° Fah. and atmospheric pressure. Considered as a heat engine the engine makes an excellent showing. Of the total heat of combustion 19.6 per cent. is turned into work. Throughout these tests the working of the engine was excellent the control by throttling being practically perfect within the limits of the experiments, and being attended by no decrease in economy with low speeds. A very small amount of lubricant was required.

Irrigation Abroad.

Some interesting data concerning irrigating practice in foreign countries is furnished by the reports of the Commissioners on Irrigation of California, and notwithstanding the fact that a great deal has already appeared in these columns on this subject, the report contains such a full account of the extent and methods of irrigation employed in foreign lands that a brief abstract of it is deemed worthy of presentation.

In Italy, India and Spain irrigation is conducted on the grandest scale, and millions of people depend for their sustenance upon areas made productive in this way. In many other countries, amongst them England, France, Egypt, West India Islands, Mexico, Peru, and in the United States, in California, Nevada and Utah, irrigation is of very great importance, but the magnitude of the work in these countries is not to be compared with that in the countries first named.

India. With its vast population of 200,000,000, the country requires more than a fair harvest to prevent famine in many localities, and it is this motive which has led the Government to build enormous canals and irrigating appliances. The works in course of construction and projected are estimated to cost $175,000,000, and the rate of expenditure is now many millions annually. The work can be done cheaper in that country than in almost any other, as the wages of a skilled laborer are only 50 cts. per day, and of an ordinary laborer 12 cts. per day. Earth excavation can be made for 5 cts. per cu. yd., and masonry from $1.50 to $3 per cu. yd. In India four systems are in operation: Canals, tanks or reservoirs, the inundating system, and wells. The Ganges canal is 10 ft. deep, 170 ft. wide at its upper part, 900 miles long, and is intended to irrigate 1,500,000 acres. It can carry 7,000 cu. ft. of water per second. It cost about $12,000,000, and would probably have cost many times as much in this country. This canal is navigable and was built and is owned by the Government. There are several others which rival it in magnitude and importance.

The tank system prevails in Madras, where it is said there are 53,000 tanks, with 30,000 miles of embankment, and 300,000 separate masonry sluices and weirs. They are generally shallow, from 6 to 10 ft. deep. The earth for the walls was carried in baskets and deposited in layers from 6 to 8 ins. thick and then packed by the feet of the natives. Four posts were placed in the crest of the waste weir so that a light dam could be constructed to hold the water as high as possible, but would be swept out in case of a flood before the water reached the top of the embankments. The Government owns these tanks and the revenue from them is $7,750,000. Some of them are supplied by natural drainage and others by artificial channels. Their number is decreasing, however, some being filled with silt and others being replaced by the canal system.

Inundation canals were formerly much used, but are now being superseded by permanent or perennial canals. As they depend upon freshets for their supply of water, they are very uncertain and are also especially liable to get out of order.

Wells furnish a very large area with water. They are square pits lined with masonry, and are from a few feet to 60 ft. in depth, each well watering from 3 to 10 acres. The means of getting the water out of these wells and distributing it is extremely crude.

Italy. The first canal of which there is an authentic record was built in the twelfth century. The large Muzza canal was built in 1520. The rainfall in Italy is about 37 ins. or 38 ins. annually in Lombardy and about 22 ins. in Piedmont, but notwithstanding this fact a very large area is irrigated in these provinces.

Italy uses about 24,000 cu. ft. of water per second, and 1,600,000 acres of land are irrigated. In the 700 years in which irrigation has been practiced in Lombardy, it is estimated that $200,000,000 have been expended, with the result that the whole country is a garden. The State owns most of the canals, but irrigation associations are formed to administer affairs in the various localities.

Spain.—With its high temperature and scanty rainfall, Spain needs irrigation more and repays it better than almost any other country. Irrigated land is often worth from $700 to $900 per acre, while the same land without such improvement is only worth $80. The Spaniards received their ideas of irrigation from the Moors, and many of the older systems are the work of that people. The area of land irrigated in Spain is, according to official reports 4,439 sq. miles. The principal canals, however, only irrigate 500,000 acres, the multitude of smaller canals and reservoirs furnishing water for the remainder. Wheels with buckets attached are very generally used for lifting the water. The motive power is either animals or the current of the stream. Most of the canals are owned and operated by capitalists but under very strict Government regulations.

In France irrigation is more of a local than national enterprise. The rainfall is from 16 to 32 ins. annually so it is not a necessity. In England there are now extensive water meadows and irrigation on the Italian plan has recently been attempted.

Iron and Steel.

The annual report of the American Iron and Steel Association for 1887, furnishes the following interesting figures of the trade during the last few years in the United States and Great Britain:

The pig iron production of the United States for 1887 was 6,417,148 gross tons, against 5,683,329 in 1886, an increase of 13 per cent. Of this 60 per cent. was made of bituminous coal and coke, 26 per cent. by coke and anthracite, 6 per cent. by anthracite, and 7 by charcoal. The Southern states, including Missouri, made 829 854 gross tons, an increase of 7 per cent. over 1886, and of 134 per cent. over 1880. On January 1 seventeen coke and two charcoal furnaces were building in Alabama and Tennessee, which will bring the daily capacity of that region up to 4,000 tons by about July 1.

The following table gives the production of the United States and the United Kingdom during the last decade, with this country's percentage of their joint production and the average price of No. 1 anthracite in Philadelphia:

	Production in the United States.	Production in Great Britain.	Percentage made in the United States.	Price.
1879	2,301 215	6,300,000	26.9	$17.63
1879	2 741 853	6 009 434	31.3	21.50
1880	3.853,191	7,721,833	33.2	28 50
1881	4,144 254	8,377,346	33.1	25.13
1882	4,623.323	8,493.287	35.3	25.75
1883	4,595.510	8,490,224	35.1	22.38
1884	4,097 868	7.528,9.6	35.2	19.88
1885	4,044,526	7,250,657	35.8	18.00
1886	5,683.329	6 870.6?5	45.3	18 75
1887	6,417,184	7,441,927	46.3	21.00

The production of Bessemer and Clapp-Griffiths steel in 1887 was 2.936,633 gross tons, a gain of 29 per cent. for the year. Pneumatic steel was made in eleven states, against nine in 1886, the two new states being Virginia and Indiana. Pennsylvania made 53 per cent. of all the ingots produced, against 59 in 1886, and 65 in 1885. Illinois made 26 per cent. in 1887, 21 in 1886, and 22 in 1885. Eight new Bessemer and three new Clapp-Griffiths plants were completed in 1887, and three new works were building at the beginning of 1888. The total of completed Bessemer plants at the close of the year was 43 with 89 converters.

The production of steel rails was 2,049,638 gross tons, against 1,526,410 in 1886, and 959,471 in 1885. Pennsylvania's relative production has fallen from 68 per cent. in 1885 to 53 per cent. in 1887. Illinois has increased from 28 per cent. in 1885 to 32 per cent in 1887.

The production of steel rails and ingots in this country and Great Britain, with the price in America, is given in the table below, in which each unit of production represents 1,000 gross tons:

	United States.		Great Britain.		American.
	Ingots.	Rails.	Ingots.	Rails.	price.
1878	654	491	808	634	$42.00
1879	829	611	835	519	48 25
1880	1,074	852	1,044	740	67.50
1881	1,374	1,188	1.442	1.024	61.13
1882	1,515	1,284	1,674	1.236	48.50
1883	1,477	1,149	1,553	1,097	37 .5
1884	1,376	997	1,300	785	30.75
1885	1,519	959	1 304	707	2?.50
1886	2,269	1,502	1,571	720	34 50
1887	2,936	2,050	2,064	1,023	37.13

THE closing of the great breach in the embankment of the Yellow River, in China, has, it is said, been abandoned by the officials appointed, as impossible to be carried out during the present season, as

the annual floods caused by the melting snows of Thibet, and the Kokonor region will probably convert a great part of the district into an inland sea.

Methods and Cost of Working by Steam Excavators.

Some valuable data on this subject is contained in the latter part of Mr. W. L. CLEMENTS' paper on this subject read at the Seventeenth Meeting of the Society of Mechanical Engineers, the first part of which was abstracted in our issue of May 26. We add to a full abstract of this, much information obtained from other sources, the whole giving a very clear idea of the working and economy of steam excavators in modern practice, for lowering grades, widening cuts, or furnishing ballast or filling. Concerning the equipment Mr. CLEMENTS says:

In addition to the excavator itself there are ordinarily required one or more locomotives for transferring cars, from 75 to 150 gravel cars properly fitted for the operation of the gravel plow and the gravel plow or ballast unloader with its cable and connections.

For the operation of the machine, an engineer, fireman, cranesman and several laborers for work in the pit, preparing a way for the machine are required. The train crew consists of the ordinary working crew together with other men for the direction of operations.

Fig. 1 represents the plan of a shovel's work in a cutting. The main line is open, at least for a distance allowing the length of the gravel train beyond the position of the excavator. If traffic is upon the line, there is usually a side track of sufficient length to allow the gravel train to remain upon it, preventing the interruption of traffic. In loading these cars, operations are commenced either from the rear or forward end of the train, and as each car is loaded the succeeding one is hauled into position to receive material. After the completion of the train load the train awaits orders, or is transferred immediately to the point of dumping, and it is there that the gravel plow or unloader is of use.

Fig. 2 illustrates such an unloader very often used. The gravel cars for use with this appliance must be fitted with a center board or wooden strip placed on each car as shown, and running the entire length of the train. To the plow is attached a wire cable running the entire length of the train, and with this cable attached to the draw-head of the locomotive, beginning with the farthest car, the material may be thrown from either side of the train. It accomplishes its work rapidly, and a train length may be unloaded at the rate of about 2 ft. per second. Its construction is simple, having a cast-iron or steel head piece to which are riveted wrought-iron side pieces, so curved and formed that they may work under the material and push it aside, while the weight of the material itself keeps the plow on the track, and prevents it from riding on the material.

The excavator is sometimes worked in material requiring the aid of blasting to loosen it preparatory to the work of the machine. When so working, the greatest skill of the attendants is necessary, for if this is not exercised, and the machine used as for ordinary work, it is likely to be subjected to strains which it cannot endure. However, with care, the machine may endure indefinitely the most severe work in rock digging, and its use for the removal of such material has been found very economical.

In the hardest kinds of clay, in cemented gravel or hard pan and in ordinary gravel or sand, the shovel performs its functions most satisfactorily, and for this service is ordinarily used. The machine very often works in material interspersed with large boulders and strata of concrete gravel or tenacious clay, and so hard as to leave a vertical trace of the teeth of the dipper in the bank.

The cost of the removal of earth by these machines depends upon local circumstances, quality of material, and upon the skill with which the machine is operated. Another important feature affecting the cost is the constancy of operation. Delay may be occasioned by waiting for right of way, by an insufficient number of cars, and other causes; but whatever the cause, any delay adds greatly to the cost of excavating. Mr. HILL, in a paper read before the Illinois Society of Engineers and Surveyors, suggests, as a preventative of delay the complete overhauling and repair of the excavator and all the accompanying appliances, before beginning a piece of work. The shovel should be moved while the train is unloading, and if the haul is long and bank high, cars should be left to be loaded while the train is absent. With a very long haul and light bank two trains can be used to very good advantage.

On this subject Mr. CLEMENTS continues as follows:

In the operation and management of a railway the gravel train is accepted as an outcast, and the right of way for transportation from a gravel pit to its destination along the line is only given when all other trains have had their way, and, as a result, by the detention of the train the operation of the shovel is often stopped and its results severely affected. These detentions

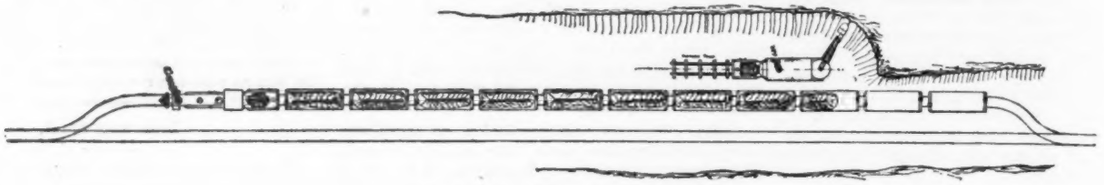


Fig. 1.—Plan of Excavator at Work.

are most common occurrences, and it may be said that only in exceptional cases are excavators kept constantly at their work, and when from fortunate circumstances or by good management they are kept in constant operation, their results as to volume of material removed and cost per cubic foot are reduced often one hundred per cent. As a consequence, there are very few reports furnished by contractors or operators, without some limiting conditions affecting materially the cost of the removal of the material. The reports now in possession of the writer from excavators which have been in service in many parts of the United States may give an idea of the cost of excavation with good management and fairly satisfactory conditions.

From a report of the General Roadmaster of the New York Central & Hudson River Railroad Co., of work done by two shovels on the Eastern and Western Divisions, we find the largest day's work for one shovel at Yost's pit was 174 cars, the average for the month of August being 121 cars per day, and for July 116 cars per day. We could have made a larger average than this with twenty more cars. The trains making long runs could not keep cars in the pit.

The largest day's work at Bergen pit with one machine was 156 car loads, the June average being 117 cars and the July 116 cars per day, and for two weeks in August 134 cars per day. At this pit they came in contact with cement, hard pan, and very coarse material.

At Yost's pit they have loaded 10 511 cars in four months up to Aug. 1. I have figured these at 9 yds. per car, which is low, making 94,599 yds. The cost of delivering on roadbed was $5,261.25 or about 5½ cts. per yd. The average cost for handling by men loading and unloading is 14 cts. per yd.

The report of a machine working in New Mexico on the line of the Atchison, Topeka and Santa Fè, says: "In this material, cemented gravel, we find no difficulty under favorable circumstances in loading 75 to 100 cars per day, at a cost not to exceed 10 cts. per cu. yd."

The engineer of the Cleveland, Mt. Vernon & Delaware Railroad gives some statements as to the cost and amount of some excavating work done under his direction. This shovel worked about 5¾ months in stiff clay.

In March	loaded	1154	cars, worked	24	days.
" July	"	955	" "	24	"
" Aug.	"	1157	" "	22	"
" Sept.	"	1:56	" "	23	"
" Oct.	"	1552	" "	23	"
" Nov.	"	539	" "	12	"

A total of 6915 cars, 41,490 yds. Greatest number of cars loaded in a single day, 97. Shovel supposed to work 10 hours a day, but did not average more than 6¼ hours on account of waiting for cars. Car loads average 6 cu. yds. per car. Average cost of loading is 3 cts. per cu. yd., including expense of all men, shovel, oil, waste, etc. Loaded, hauled material, and unloaded at a distance of ten miles from pit, at 10 cts. per yd., including all costs, shovel, use of cars, engines and crews. A 20 mile haul on this road costs 15 cts. per yd., and a 30 mile haul about 20 cts. per yd., while I have known some roads on which a 30 mile haul costs over 75 cts. per yd., depending on frequency of trains running on road.

The reports show how variable is the cost of excavating, depending as it does upon delay unavoidable on every line of railway, upon the weather, character of the material, length of haul, and many other conditions. When conditions are favorable as to material, prompt and short hauling, with no delays, the results show a very large increase in the output, and often a decrease in cost. The following report from the Superintendent of the Sioux City & Pacific Railway gives the operations of a shovel for nine months working in a yellow clay bank from 30 to 40 ft. in length, and with a one-mile haul:

"The total number of cars loaded was 31,420 in 209 days, giving an average of 150¾ cars per day. The greatest number of cars loaded in one day was 275, with an average of 6 cu. yds. per car. The average cost of loading per cu. yd. is 6½ cts., including expense of all men about shovel, and shifting of shovel track. Average cost of unloading with one-mile haul, 7.8 cts., including wages of all men with trains and engines, use of cars and locomotives, with all supplies and repairs of same, making a total cost of 14.3 cts. per cu. yd. or 85.8 cts. per car delivered on track.

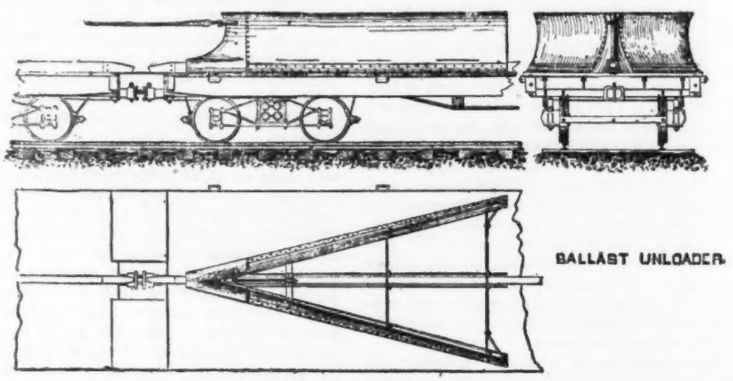


Fig. 2.—Plow for Unloading Cars.

A report showing the largest amount of work, with the most complete detail as to the expense of operation is furnished by the resident engineer of the Missouri Valley & Blair Railway & Bridge Co., contractors for the Chicago & Northwestern bridge across the Missouri river at Missouri valley, the material excavated being used in the approaches to the bridge.

The work, a tabulated statement of which is herewith given, was done under the most favorable circumstances, with but few delays, and with but one locomotive, as the cars ran down the hill themselves while being loaded, the locomotive being employed to haul the empty cars back; the haul was short and a round trip was made in 30 minutes.

The report shows that during the work of six months the average number of cars loaded per day was 205, including delays and movings, and that the average cost per cu. yd. was 7 cts., which as shown, included labor of loading, moving shovel about once a month, moving track to suit, dynamite for caving bank, repairs of

shovel, fuel, oil, waste, wages of watchman, rent of cars and locomotives, labor of engineers, firemen and wipers, labor, conductors and brakemen, and in fact absolutely everything connected in any way with filling the embankment.

Statement of Work done by a Steam Excavator in Six Months at Missouri Valley, Ia.

Repairs to Locomotive, Shovel and Cars. Material	$ 457.14
Repairs to Locomotive, Shovel and Cars. Labor	211.80
Supplies for Shovel	1,760.00
Rent of Locomotives and Cars	1 404.75
Supplies for Locomotives	1,781.52
Wages of Locomotive Attendants	1.508.37
Wages of all other Employes	10,680.01
Total Cost	$17,703.59
Cars Loaded	32,141
Cost per Car	55.38 cts.
Cost per Cubic Yard	7. cts.
Hours Worked by Gang	2,325
Hours Worked by Shovel	1,926

The report of the Roadmaster's Association for 1885, gives the cost of steam shovel work as follows:

Road.		Cost per yd. in cts.
B. & O.	Including everything, haul 5 to 25 miles	8.1
Mich. Central.	Loading	4.5
Mich. Centra'.	Hauling, 30 miles. Labor Only	4.
N. Y. P. & O.	Loading	7.
Central Iowa.	Loading	4.75
"	Unloading	1.9
"	Engine Service	3.1
"	Total.	9.75

Mr. HILL'S detailed statement of work on the Indianapolis, Decatur & Springfield R. R., given herewith, shows marked economy and gives an excellent idea of how the expenses are apportioned. The Otis type of excavator was used, which cuts 24 ft. wide and to a depth of 4 ft. below the track. The banks were about 15 ft. high, the average haul 4,000 ft. Twelve flat cars constituted a train. By a special cable arrangement the time of plowing off, ordinarily requiring about 15 minutes, was reduced to 5 or 6 minutes.

Steam Shovel Work, I. D. & S. Ry. Supervision of A. J. DIDDLE, *Roadmaster.*

Data.	Sangamon River Trestle.	Montezuma Gravel Pit.	Sangamon River Trestle.	Guion Trestle.	Nichol's Hollow Trestle.
Total number of days	1885	1886	1886	1887	1887
Number of Working Days	54	186	48	108	51
Days idle in addition to Sundays	46	115	38	85	40
Nature of material handled	0	45	3	7	4
Average height of bank	light clay.	Gravel.	light clay.	light clay.	light clay.
Total number of cars loaded	10 ft.	12 ft.	10 ft.	10 ft.	12 ft.
Greatest number of cars loaded per day	2899	8631	2771	5254	2528
Least number of cars loaded per day	94	124	99	80	75
Average number of cars loaded per day	22	16	50	30	15
Average length of haul	63	75	73	61.8	63.2
Grade—shovel to dump—feet per 100	1 mile.	9 miles, varying.	1 mile.	2 miles.	¾ mile.
Tons of coal used—shovel and engines	—1.00		—1.00	—1.00	—1.00
Number of car loads per ton of coal	141	853	99	170	65
	20.5	10	28	30.9	38.9

COST OF WORK PER CAR-LOAD.

	Cts.	Cts.	Cts.	Cts.	Cts.
Foreman at $125 per month	8.86	9.67	8.00	9.01	9.88
Cranesman at $2 to 2.50 per day	5.35	5.62	4.80	3.54	5.57
Fireman (shovel) at $1.50 per day	2.88	3.37	2.87	2.90	3.27
Laborers (4) at $1.25 per day	7.86	9.92	8.77	9.80	9.80
Watchman at $1 per day	2.07	1.96	1.88	2.50	2.25
Total shovel crew	27.02	30.54	26.32	27.75	30.77
Engineer and Fireman (engine)	12.09	14.50	7.44	11.00	13.10
Trainmen (conductor, $2.50; brakemen, $1.50)	5.97	14.60	5.74	5.25	5.77
Total train crew	17.97	29.10	13.18	16.25	18.87
Helpers distributing earth at $1.10	....	1.74	....	....	2.72
Section men (track work) at $1.10	0.81	1.88	1.38	1.45	....
Bridge Carpenters (repairs to plant), $2.50	0.15	1.58	0.16	1.04	2.08
Section men (repairs to plant) $1.10	....	0.62	....	....	....
Shop bills (repairs to plant)	1.69	10.90	1.27	10.60	1.67
Total repairs to plant	1.84	13.10	1.43	11.64	1.67
Coal at from $1.25 to $1.41 per ton	6.31	13.30	4.47	4.31	3.28
Oil, waste, etc	0.52	1.55	0.75	0.86	0.36
Total supplies	6.83	14.85	5.22	5.17	3.64
Grand total per car-load	54.47	91.19	47.53	62.26	59.75
Cost per yard at 8 yards per car	6.43	11.40	5.94	7.79	7.47
Add per yard for interest on cost of plant	1.00	1.00	1.00	1.00	1.00
Cost per yard including interest	7.43	12.40	6.94	8.79	8.47

There is no doubt that, for work in connection with the maintenance of way the excavator is steadily growing in favor. Competition has served to increase the efficiency of the machine and reduce its cost, and at present there are very few railway lines not equipped with steam excavators.

THE Bethlehem Iron Co. made, on May 10, what is said to be the largest single casting ever attempted in America, being the base for the large steel compressor to be used in the new gun works. There was poured into the mould 124 tons of metal. The cast will require several weeks to cool, and is thought to be successful.

Abstracts of Papers Presented at the Seventeenth Meeting of the American Society of Mechanical Engineers.

(*Continued from page* 422.)

Duty Trials of Pumping Engines.

The word "duty" as it occurs in water-works' contracts, is very rarely clearly defined, and Mr. J. S. COON'S attempt to throw some light upon the subject and give this term a definite meaning is worthy of commendation. Without attempting to lay down complete rules for conducting a test, Mr. COON has pointed out several methods for securing more uniformity and accuracy and a better standard for comparing the efficiencies of different plants.

In contracting for a high duty engine, it is customary to specify either that so many foot pounds of work shall be done by the consumption of 100 lbs. of coal, without reference to the efficiency of the boilers; or, to predicate an evaporation of 10 lbs. of water per pound of coal, and require a certain number of foot pounds of work to be done per 1000 lbs. of water evaporated. If the efficiency of the boilers is not considered, it is not wise to test the boilers while the duty trial is being made, as the temperature of feed water is generally reduced during the boiler test.

When the contract calls for a certain evaporation per pound of coal, it is customary to assume 10 lbs. without regard to temperature of feed water. With this manifestly inexact method of stipulating the performance, it is only necessary to weigh the feed water, which might be ice cold and yet give the same duty as at 200° Fah., and engine builders might ignore all feed heating appliances.

Mr. COON says:

If the duty were predicated on an evaporation of 10 lbs. of water per lb. of coal *from and at* 212° Fah., or better still, per lb. of *combustible* from and at 212°, that at once changes the conditions entirely, and compels the contractor to adopt economical means for procuring hot feed water. It also changes the character of the duty test.

It may be urged that, in some instances, such a stipulation would be unjust to the engine builder, as, for instance, where the contract for boilers was not taken by the engine builder, or where a new engine is supplied to old works having sufficient boiler capacity; but it is equally unfair to compare the performance of different styles of pumping engines on a basis of 10 lbs. of water evaporated per pound of coal without taking into account the feed water temperature, and the temperature of evaporation. Thus the injustice is manifest of comparing the duty of two engines, on the ten to one basis, one of which was supplied with feed water at 200° Fah. and used steam 75 lbs. gauge, and the other with feed water at 90° Fah. and steam at 125 lbs. gauge, without also taking into account the difference in their factors of evaporation, which, in the case cited, amounts to about 12 per cent. which is the difference between a 90 million duty and one of over 100 millions.

The method of starting and stopping the trial is of prime importance. Where a running start is made, without drawing the fires and kindling new ones, a wide margin for guess-work is possible, particularly if the trial be a short one. The expert's prejudices for or against the engine must necessarily influence his judgment as to the condition of the fires at the close of the trial as compared with their condition at the beginning; and there is absolutely no way of making those conditions exactly the same. Whereas, if the test is started with fires newly kindled, no element of uncertainty enters into the test.

A method of starting and stopping a trial which appears to be free from objectionable features is as follows: After all preparations for making the test are completed, with the engine running, let the fires burn low, until in consequence the steam pressure falls to a point where it is little more than sufficient to keep the engine running. Then stop the engine and rapidly draw the fires with closed dampers and ash doors, so as to lose as little heat as possible. As quickly as possible kindle new fires with weighed wood charged to the experiment at 0.4 of its weight in coal equivalent. At the instant the fires are relighted the test begins at the boilers, and time should be taken, the steam pressure recorded, and the height of the water in the boilers carefully noted. When the fires are in sufficiently good condition, and steam pressure raised to nearly or quite the pressure to be maintained during the trial, the engine is to be then started, the engine counter taken, and the time also, for this is the beginning of the test so far as the engine capacity is concerned. After the last firing, care should be taken to leave as little unconsumed coal as possible, and when the steam pressure has dropped to the point at which it stood when the fires were lighted, time is taken, which is the close of the trial both for engines and boilers. The counter is read, and the fires are immediately and quickly hauled, so that any unconsumed coal may be picked out and deducted from the total charged to the experiment. The water level in the boilers should be as nearly as possible the same as at the beginning of the test, and any difference in level allowed for by calculation, and not by pumping or blowing off.

The reason for starting with new fires, and stopping with low steam pressure is that by this plan all the fuel may be consumed.

When a weir notch is used to gauge the delivery of the pumps, it is desirable to make the start with the engine running. In some cases power to keep the engine running just at the start may be obtained from boilers not undergoing tests, and the method of starting recommended above still be used. When a running start is imperative and no surplus power is obtainable, the duration of the trial should be longer than where the fires are freshly kindled. As regards the length of test there is much to recommend 24 hours, as it would enable the expert to be present all the time without inconvenience, and is long enough to give a fair record of the capability of the plant.

Mr. COON continues:

Another point upon which there is lack of uniformity in the published reports of duty trials is the basis upon which the duty is figured. This is a matter of great importance and the report should clearly state whether the duty is based on plunger displacement or actual delivery. There are many situations where it is impracticable to gauge the actual delivery of the pumps by weir measurement, or reservoir capacity, and where it is also impossible to know the loss of action, or "slip" of the pumps. In such cases it has been customary either to guess at the slip, or to figure the duty on the plunger displacement. Since, therefore, in some instances neither the delivery or slip can be known, in every report a figure should be given for the duty based on the plunger displacement. Not the nominal displacement of the contractor, but by measurements made by the expert in charge. The difference between the nominal and the actual plunger displacement has amounted, in the writer's experience, to more than 1 per cent. And unless the contract specifies that the duty shall be figured on the water actually delivered by the pumps, the work of the engine should be based on the plunger displacement.

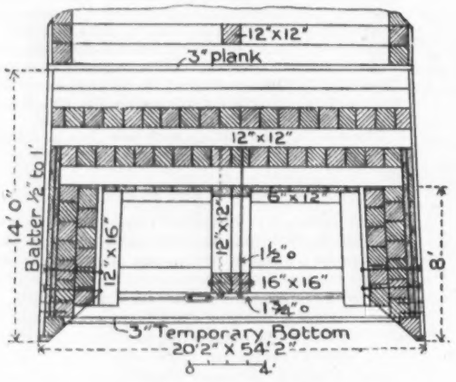
The horse-power figured on the work done in the steam cylinders is the indicated power. The horse-power figured on the plunger displacement is the net power. Both of these can in all cases be determined, and their difference is the friction of the machine. The ratio of the net power to the indicated is the efficiency of the machine, which ought always to be given, but very rarely is, in expert reports. The effective power is figured on the water delivered.

In published reports of duty trials there is also a want of similarity in the allowance for friction in the pump. In many reports an allowance of 1 lb. per sq. in., or 2.31 ft., has been added to the total head for friction of the water

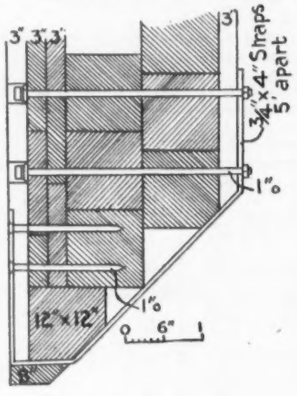
in passing through the pump valves and chambers. In other tests no allowance has been made for friction, even where the expert was at liberty to use his discretion. In still other contracts it is expressly stipulated that no allowance shall be made for friction. This at once places the published duties of some engines in an unfair position for comparison, for in the case of a pair of engines known to the writer, working under a low head, if an allowance of 1 lb. had been added, the duty would have been increased 7 per cent. over the published figure. It is manifestly as fair to allow the 1 lb. for friction on a 30 ft. head as on one of 130 ft., as the pump friction, at the same speed, would be practically the same.

The friction of the engine as a whole being also about the same under a low head as under a high one, the percentage which that friction is of the total work done is greater under a low head than under a high one. For this, among other reasons, a high head is favorable for the higher duty. Therefore, since the allowance of 1 lb. for friction tends to offset this advantage, it would seem to be desirable to allow it in figuring the duty for purposes of comparison.

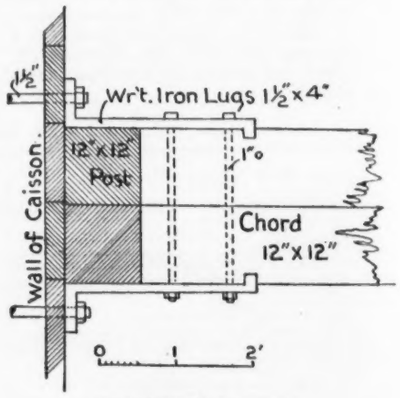
When the contract calls for a specified number of foot pounds of work to be done by the engine for each 100 lbs. of coal supplied to the boilers, with no reference to the quantity of water to be evaporated per pound of coal, that places the plant as a whole on its merits, not merely the engine and boilers, but all the appliances used in connection therewith. Thus it would seem the part of economy to attach the feed pump for supplying the boilers with feed water to the pumping engine, and thus gain the economy due to having the feed pump driven by the large engine instead of having the feed water supplied by a direct acting steam pump, whose duty could not exceed 10,000,000 ft. lbs. per 100 lbs. of coal. If this very obvious chance for economy is omitted it would seem that no allowance should be made for the steam used by the steam pump in pumping the feed water, for



ection of Pneumatic Caisson.



Shoe Detail.



Bottom Chord Connection.

Fig. 4.—Pneumatic Caisson. Fort Madison Bridge.

t is a part of the plant furnished by the contractor, who has agreed to do a certain amount of work with a certain quantity of coal. Neither should any allowance be made for the work expended in working the feed pump when it is attached to the pumping engine.

The work done in driving the boiler feed pump, when driven by the main pumping engine, amounts, in general, to less than one-fourth of one per cent. of the work done in the main pumps. To run a direct-acting steam pump for feeding the boilers would require, for a 120,000,000 duty engine, 2½ per cent. of the total coal supplied to the boilers.

The coal and water used per hour per indicated and net horse-power are important and interesting information, and very easily obtained; yet this is rarely to be found in the published reports of expert trials. It is only necessary to take a dozen complete sets of indicator cards from the steam cylinders, and note the simultaneous pump resistances. From these data the friction and efficiency of the machine can be obtained, with which after figuring the net horse-power for the whole trial, on the plunger displacement, the indicated horse-power for the whole trial can be calculated.

To avoid errors in recording the quantity of water supplied to the boilers, the water should be weighed on scales, and not gauged. No attempt should be made either to fill or empty the weighing tank to any particular figure. The attendant is not nearly so apt to omit a record if he fills and empties the tank at random, and records the actual weights thus obtained. A time record should be kept on the water-log, recording the time when the weighing tank is emptied.

It is desirable to know the quality of the steam, as to moisture. If the steam is superheated, the amount can be determined by an accurate thermometer screwed into the steam pipe, rather than by a calorimeter. In these days of splitting hairs for any advantage which may help to raise the "duty", where the contractor for the engine does not furnish the boilers, and the duty is to be figured per 1,000 lbs. of steam, if the steam shows any moisture on the test, the contractor will probably claim *dry* steam. Then, for purposes of comparison, *all* duty tests should be figured on a basis of *dry* steam, and the same remarks apply to the coal. The duty should in all cases be figured on *dry* coal.

The Fort Madison Bridge Across the Mississippi River.

BY W. W. CURTIS. RES. ENGINEER

(*Concluded from page* 441.)

Fig. 4 shows the bracing of the working chamber, with detail of the shoe and bottom chord connection. Pier No. 7, Fig. 5, while out of the main channel, is yet in deep water and subject to considerable scour. A scour may possibly occur here of 12 ft., as the river accommodates itself to its contracted channel.

If the piles had merely been cut off at the original elevation of the river bed, it is possible that after the first high water, the sand would have been washed out, leaving the piles unsupported for some feet. This could have been prevented somewhat by a large amount of rip-rapping, constantly watched and added, but the risk would have been considerable, and it is moreover undesirable to diminish the cross-section of the river by increasing the obstruction of the piers. To meet these conditions, a bottomless crib was used. Its construction is sufficiently indicated by the sketch.

The crib, Fig. 6, was built on launching rails, with a false bottom, floated into position and the bottom removed. After concreting the space between the walls, the suction pipes from two centrifugal pumps, set upon a barge alongside, were introduced through openings in the sides and the sand pumped out.

The crib was given sufficient weight in itself to overcome the friction upon its sides, so that it would sink gradually, as the sand was pumped from the interior. To expedite the sinking, several water jets were kept at work, forcing the sand away from the cutting edge; and when nearly at the proper depth, the crib was loaded with rock on top to give additional weight The material passed through was sand with a considerable proportion of large gravel in it and some streaks of hard material.

After the crib was down to the required depth the piles, 50 ft. long, were driven 25 ft. into the sand, and then cut off at the level of the bottom of the crib.

The caisson, consisting of 4 ft. 3 ins. of grillage, with 11 ft. of concrete enclosed in a timber crib, surmounted by a coffer-dam, was then sunk upon the piles, as at piers 2, 3 and 4.

The foundations for 8, 9 and 10 are of the same character, differing only in depth.

In the construction of these cribs it is necessary to pay great attention to the framing, securing as stiff a structure as possible, as it is very severely racked during the sinking. If undertaking to sink more of the same, or of greater size, they would probably be arranged either for clam shell dredges, or for the use of pulsometers. The latter could, undoubtedly be worked more easily and conveniently, and probably to a greater depth than the centrifugal pumps, whatever may be their respective merits as to the economy of steam.

The piles on the sand bar were driven by a drop hammer and two water jets, acting together. The piles were quickly jetted to within 5 ft. of their intended depth, then driven the rest of the way.

The jet pipes were 2 ins. in diameter, and were held to the piles by several pairs of boat spikes, bent over the pipe. They were regulated in their descent by hand lines run through blocks at the head of the driver, and were pulled out by the engine. The foot of the pipe was bent slightly to correspond to the sharpening of the pile, and the orifice was reduced to 1 in. in diameter. By this method no pipe is lost and no holes bored in the pile.

The pressure at the pump was but 60 lbs. per sq. in., and with a more powerful pump much deeper penetration could be secured.

At Pier 7, sixteen 50 ft. piles a day were driven 5 ft. into the sand.

Table of Physical Requirements.

Material.	Ultimate strength per sq. in.	Minimum limit of elasticity per sq. in.	Per cent. of elongation in 12 diameters.	Per cent. reduction of area at fracture.	Cold Bending.	
					Angle to which specimen must bend without breaking.	Diameter of bend in terms of thickness of specimen.
IRON:						
Bar iron	52,000	26,000	18	25	180°	1½
Channels and I-Beams, Flange	50,000	26,000	15	20	140°	1½
I-Beams, Web	47,000	25,000	12	18	140°	2
Angles	50,000	26,000	15	20	140°	1½
Plates Under 18 in. wide.	50,000	26,000	13	18	140°	2
Plates 18 to 36 in. wide.	48,000	25,000	10	15	140°	3
Plates 36 in. 54 in. wide.	47,000	25,000	8	12	90°	
Plates Over 54 in. wide.	46,000	25,000	8	12	90°	
Low steel that may be substituted for iron at iron unit strains	55,000 to 65,000	30 000	20	42	180°	1

Two kinds of centrifugal pumps were used, one with a 6-in. and the other with an 8-in. discharge. The former was not well adapted to the work, its suction being produced by the revolution of iron plates riveted to an enlargement of the shaft. The fragments of rock met with, broke these plates frequently.

The larger pump was one of VAN WIE'S make, the fan being one solid piece of cast-iron. It worked well until the lift for the sand was about 26 ft., when a rather compact layer being reached, the pump would not lift anything but water.

MASONRY.

The stone for this work is a soft magnesian limestone, unaffected by frost and easily worked. It is from the quarry of Mr. J. A. GREES, Stone City, Ia., and came in courses 15 ins. to 32 ins. thick.

In the pivot pier concrete backing was used. In all concrete the use of as many large stones was allowed as could be well bedded by ramming them, provided, however, that the space between them should not be less than 6 ins., and that they should be at least 12 ins. from any timber.

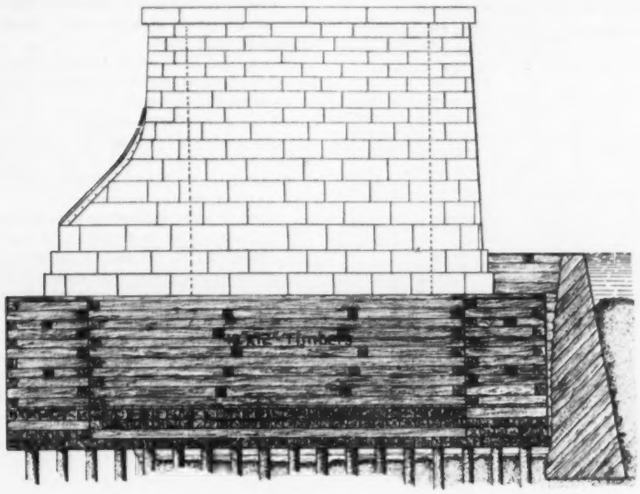


Fig. 5.—Pier No. 7.

The piers in the channel Nos. 2, 3, 5 and 6 are 9 ft. thick under the coping, and 25 ft. long between shoulders, increased where necessary for the skew spans.

The other piers are 8 ft. under coping. This width was necessary to resist the pressure of the ice. The stability of the piers was figured on the basis of the pressure required to crush ice to powder, with a considerable allowance for impact. By experiment Mr. CHANUTE ascertained the pressure required to crush ice to powder, to be 400 lbs. to the sq. in.

The coping on all the masonry projects 9 ins. beyond the face of the wall.

SUPERSTRUCTURE.

The superstructure (a half cross-section of which is shown in Fig. 7) was built by the Union Bridge Co., upon a general design submitted with their tender. This design was slightly modified and detail plans were completed under the supervision of the Assistant Engineer on Superstructure, Mr. W. H. BREITHAUPT.

A noticeable feature of the work is its massiveness. The trusses are all single intersection, with long panels varying from 25 ft. for the short spans to 27 ft. for the longer ones, and the tension members are of very large section; the largest being 8 ins. by $2\frac{9}{16}$ ins.

The top chords are bowed, resulting in economy of weight and giving a more pleasing outline than parallel chords. For the sake of uniformity in appearance, the end heights are made the same in all the trusses.

In the calculation of the stresses the assumed live load for railway was two 86 ton engines, each on a wheel base of 52 ft., followed by a train load of 3,000 lbs. per foot. This loading was increased by 25 per cent. for the floor system. Stresses due to the loading of the wagon ways were allowed for by decreasing the permissible unit strains, so as to give an increase of 10 per cent. in section throughout for all truss members. The bridge being a toll bridge, wagon loads are seldom concentrated, especially when the train load is present.

The following are extracts from the specifications for material and workmanship:

QUALITY OF MATERIAL.

General. All iron or steel as it comes from the mill must be of uniform quality for each class; straight, smooth, free from imperfect or crooked edges, and from injurious flaws of any kind, and must not vary more than two per cent. from section required.

Angles and edges of sections must be well filled out.

Up to 30 in. in width all plates must be edge rolled.

Physical properties shall be as set forth in the following table when tested, in the prescribed specimens, in an accurate testing machine, which has been compared to the U. S. Government machine at Watertown Arsenal; and if it does not agree with the latter, results must be equated so as to be the same as if obtained on said Watertown machine.

Test pieces shall be of a minimum width or diameter of 1 in., a minimum section of 0.3 sq. ins., and minimum total length of 15 ins. Elongation must be measured in at least 8 ins.

"Diameter of bend" is diameter of center line of specimen after bending.

Fractures after testing shall in no case be more than 15 per cent. crystalline.

All plates, angles, etc., which are to be bent hot during the manufacture, must, in addition to the above requirements, be capable of bending sharply to a right angle, at a working heat, without sign of fracture.

Wrought Iron. All wrought iron must be tough, ductile, fibrous and free from cinder pockets, buckles, blisters or cracks.

In rolling, all piles for plates must have both top and bottom cover plates.

Cast Iron. This must be of best quality of tough, gray iron. Bars 5 ft. long and one inch square, supported on knife edges at each end, shall sustain a weight of 500 lbs. at the middle, before breaking.

Steel. No steel which proves brittle shall be used under any circumstances. If it develops this character at any stage of its manufacture or working, it shall at once be condemned and other material used.

All steel for one class of work shall be made by the same process and at the same works.

A sample bar, ¾ in. in diameter shall be rolled from every melt for preliminary tests. If this bar fails to meet requirements, the whole charge may be rejected.

The steel shall stand such forge tests, both hot and cold, as may be sufficient, in the opinion of the engineer, to prove soundness of material and fitness for the service.

No steel must be worked at a black heat.

Steel for pins must not be hammered, but must be rolled in Gothic rolls.

Character of Work. All work must be done in a strictly first class manner and shall at all times be subject to thorough and careful inspection.

Finished pieces shall be true to size, section and line, straight and out of wind at all points; and all machine, rivet and smith work done upon them shall be of the best character.

All measurements in laying out work shall be made with iron standards of the same temperature as the iron measured.

All parts which are given a descriptive letter or number in the drawings shall have that letter or number stenciled on them before shipment. Eye bars shall have it stamped on the edge near the extreme end of the bar.

Eye Bars. All heads of eye bars shall be formed by upsetting on the solid bar, or by a process approved by the engineer. Upsets shall be free of folds. Heads shall be clean, full sized forgings formed centrally on the bar in true line and out of wind, and shall be free from lateral fissures, incipient crack or flaws of any kind.

In upsetting steel bars or rods, rough angles must be avoided where the upset joins the bar.

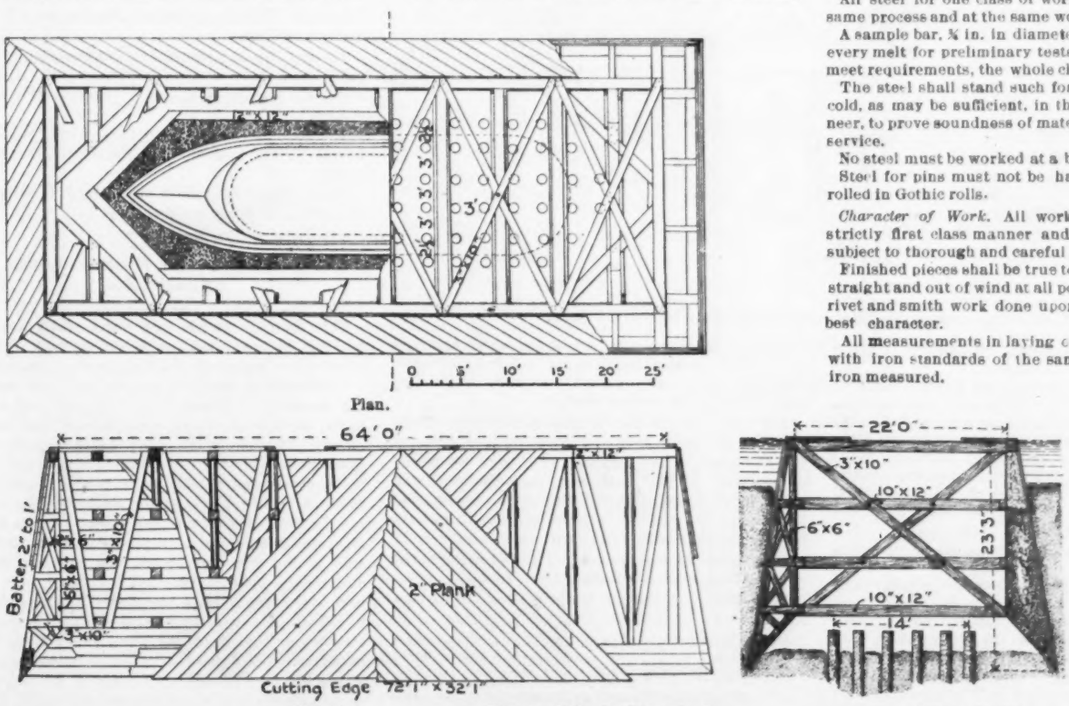


Fig. 6.—Crib for Pier No. 7.

THE FORT MADISON BRIDGE, O. CHANUTE, Chief Engineer.

All steel eye bars shall, after work on them is completed, be thoroughly annealed by heating them uniformly to a cherry red heat and allowing them to cool slowly.

Bars of the same class, and belonging to the same panel, shall be bored at the same temperature. The pin holes and eye bars shall be bored to exact sizes and distances, and to a true perpendicular to the line of strain.

The pin hole shall be in the middle of the head and in the center line of the bar.

No error in the length of bar or diameter of pin hole exceeding $\frac{1}{32}$ in. will be allowed.

Tie Rods. Rods used for ties or counters shall be fabricated with the same care and precision as is prescribed for eye bars.

Screw ends shall be upset so as to give 10 per cent. more sectional area at the least diameter of the screw thread than in the body of the bar.

All screw ends shall have truncated V threads, U. S. standard, proportions and sizes.

Sleeve nuts, clevises or other attachments used for adjustments, must be of sufficient strength to break the bar to which they are attached.

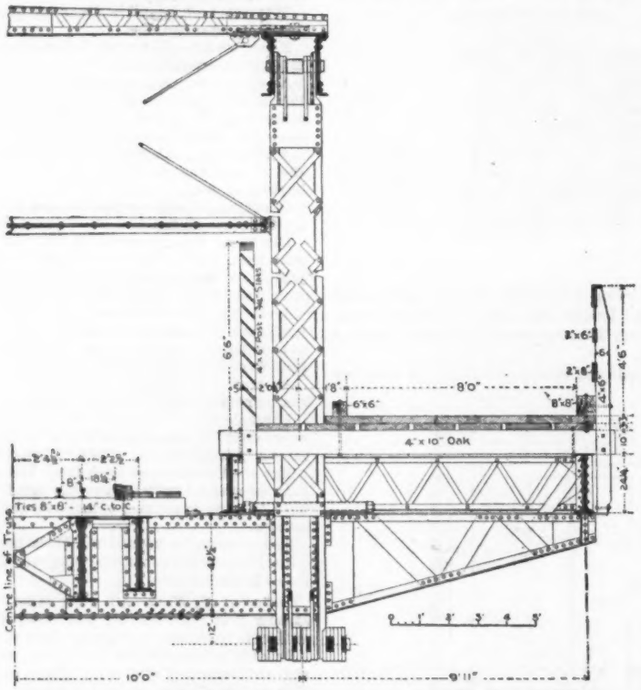


Fig. 7.—Half Cross-Section of Superstructure. Fort Madison Bridge.

Specimens. The Contractor shall furnish complete facilities for inspection of material, and workmanship, small specimens for testing of material and also the necessary labor shall be furnished by contractor without charge, when called for by the engineer or inspectors. Inspectors will be retained by the Railway Company with full power to reject all work or material which does not in every way conform to the letter and spirit of the specifications.

Mill Testing. All material shall be inspected at the mills where it is rolled.

Test specimens shall fairly represent material to be tested, and shall not in any way be worked on to alter quality before testing. They shall be cut whenever practicable so as to retain two opposite sides as they come from the rolls. Bars and rods shall be tested in full size specimens whenever small enough.

Regular bending specimens shall be taken, one for every tensile test. They should have rough edges planed off, and shall be duplicates of, and cut from the same originals, as tensile tests for the same material.

Tests shall be sufficient in number to fairly represent, in the judgment of the engineer, the material to be inspected, there shall however not be more than two full tests, *i. e.*, two tensile and two bending specimens for every 20 pieces in the order.

The passing of any material at the mills shall not prevent its subsequent rejection; if found defective after delivery, such material shall be replaced at the expense of the contractor.

Testing Finished Members. The engineer or his inspector shall from time to time as the work proceeds, select, from the finished material, full sized members for testing to destruction.

Of eye bars or rods so selected, there shall not be more than three for every hundred. These must always break in the body, must show an elongation of at least 10 per cent. of full length, and if of steel, a reduction of area at fracture of 15 per cent.

If three-fourths of the bars so selected and tested from time to time fulfill requirements, all bars manufactured to that time shall be accepted; if less, testing shall be continued at expense of contractor until, in the opinion of the engineer, enough evidence exists that at least three-fourths of all bars fulfill requirements.

All finished members taken for testing shall be paid for at cost price, less its scrap value, if fulfilling requirements of specifications; if not, the contractor shall not be paid for them.

Final Test. On completion of the structure, the bridge shall be subjected to the following test: two coupled consolidation engines shall run on the bridge at a speed of 15 miles per hour, and when the leading engine is over the center of the bridge both engines shall be reversed and no permanent change shall take place.

The bridge shall then be fully loaded with engines of the above class, and after remaining under this load for five minutes shall be found not to deflect more than $\frac{1}{1200}$ of its length, and, upon the removal of the load shall return to its original camber.

All truss pins and purely tension members, except top laterals, sway rods and counters, are made of the low steel, "that may be substituted for iron" as specified. This steel was manufactured and rolled by Carnegie, Phipps & Co., at Homestead and Pittsburg, Pa., and is very uniform. Ductility tests both in small specimens and full sized bars were in general better than required. The following is the record of an average full sized 6×1⅝ in. bar. Open hearth steel. Broke in body of bar. Fracture silky.

Ultimate strength per square inch	63,319
Elastic limit " " "	34,094
Per cent elongation in 12 ins	36.6
" " " 23 ft.	10.8
" reduction of in area at fracture	46.8

On account of being more quickly obtained, the webs of the floorbeams and stringers are of low steel manufactured and rolled by The Steel Company of Scotland. They are of the same material as that used in the Forth bridge; a material which is more reliable in its ductility and uniform good quality than the average iron that can be obtained.

Fig. 7, a half cross section of one truss, illustrates the manner of providing for both railway and wagonway.

For the railway there are four lines of stringers; two main, almost directly under the rails, figured for the full load; and two outer, figured for one-half the full load, to act as safety stringers in case of derailment.

There is an inner guard-rail of iron and an outer one of wood protected by a 3 in. × 3 in. × ⅜ in. square root angle iron.

The wagonway is raised 27 ins. above the top of rail, and is of 2 courses of oak plank laid on 4 ins. × 10 ins. oak stringers, 18 ins. apart, running transversely to the bridge axis. These are in turn supported by 2 iron stringers, extending over one panel. The inner one rests on the main floor beam just insid of the post, and the outer upon a bracket fastened to each post.

The top and bottom flanges of the bracket are riveted to the post, and the tension of the top flange is transferre i to the main floor beam by a long bolt with a nut at each end, as shown.

To prevent horses seeing the train, a fence is built between the tracks, formed of ¾-in. slats set at such an angle as to present the least resistance to the wind, and yet act as a screen.

Quantities.—The following is a statement of the total quantities of material used in the bridge: piling, 75,000 lin. ft.; timber, 2,456,000 ft. B. M.; iron exclusive of spans 260,000 lbs.; masonry, 4,412 cu. yds.; concrete, 3,440 cu. yds.; rip-rap, 8,297 cu. yds.; iron and steel in superstructure, 5,289,971 lbs.

Below are the number of pounds of iron per M. ft. B. M. timber, used in various kinds of work. They include all the various kinds of iron required, except that in the pneumatic caisson. No shafts or pipes are included.

Pneumatic caisson, not including crib	175 lbs.
Crib of pneumatic caisson	100 "
Grillage	100 "
Sand crib	70 "

The total cost of the bridge will be $600,000.

The contractors for the substructure were Sooysmith & Son with Mr. J. E. WILLARD as Superintendent, to whose ability both as a contractor and engineer, the writer takes pleasure in acknowledging his indebtedness.

The superstructure was furnished and erected by the Union Bridge Co., with Mr. CLARK GRANT as Superintendent.

Thanks to the careful management of these gentlemen, there were no fatal nor totally disabling accidents during the entire construction of the bridge,

The first pile in the permanent work was driven March 16, 1887, and the first train crossed over Dec. 7, 1887.

The assistant engineers were Mr. J. G. GILCHRIST and Mr. J. D. HUTCHINSON, C. E.

The Graydon Steam Heating System for Street Cars.

This system, which was successfully used for heating railway cars on the Vandalia line last winter, has been modified for use on street cars.

A cylindrical reservoir covered with non-conducting material is placed under the car seat, and is partly filled with water containing a large amount of salt. This reservoir is connected with the steam generator when the charging is done, and when the pressure and temperature in the reservoir are practically the same as in the generator, the connection is severed and the car is ready for its run of from one to five hours. A pipe enters at the lower side of the reservoir, continues upward spirally and makes its exit through the upper part. The part of this pipe above the water line is perforated to permit the entrance of steam, which is conveyed through a circuit of radiating pipes back to the reservoir. The flow of steam is regulated by valves. There will be a constant circulation so long as the temperature of the water remains above 212° Fah.

A small stationary boiler at the end of the line is sufficient to furnish the steam required, which Mr. GRAYDON estimates at 90 lbs. for heating one car ten hours. Assuming that a pound of coal evaporates 9 lbs. of water, the coal consumption would be 10 lbs., an average of 1 lb. per hour. This system heats the car uniformly, occupies very little space, is entirely out of the way of the passengers, and is said to have given excellent satisfaction where it has been tried.

Two other inquirers in regard to "how to obtain a position on the Panama Canal" are referred to our last week's issue for an answer; and for that matter, perhaps this week's will also be instructive.

CORRESPONDENCE.

Makers of Fine Barometers.

ALBANY, N. Y. May 28,1888.

EDITOR ENGINEERING NEWS:

In answer to the query in your issue of May 2: J. & H. J. Green of New York, make many fine meteorological instruments for the U. S. Signal Service and for others. I have used an aneroid barometer of these makers that was very handsomely divided and finished. For extreme prescision, the constants of the instrument must be determined, the method of doing this is described in detail in JORDAN'S or BAUERNFEIND'S Vermessungskunde, where mention is also made of foreign makers of repute. The microscope barometer of F. H. REITZ, of Homburg, is of fine workmanship and is ingeniously constructed. Yours truly,

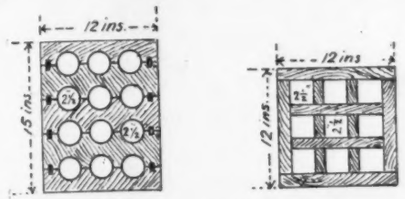
HORACE ANDREWS.

Electrical Subways of Philadelphia.

PHILADELPHIA, May 10, 1888.

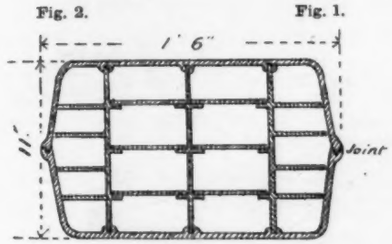
EDITOR ENGINEERING NEWS:

The article on the "Electrical Subways of New York City" which has appeared in recent issues of your valuable journal will be read with especial interest at the present time, in view of the renewed demand for the removal of overhead wires which has been awakened by the numerous fatalities resulting from accidental contact with exposed conductors of powerful electric currents. As an account, in this connection, of the subway systems in use in this city would no doubt be of interest to many of your readers, I send you a brief description of them with diagrams.



Creosoted wood conduits

Fig. 2. Fig. 1.



Cast-iron conduit.

Fig. 3.

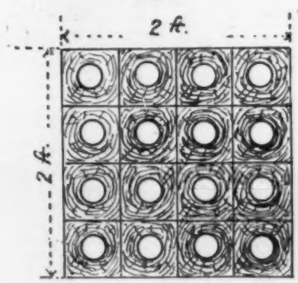
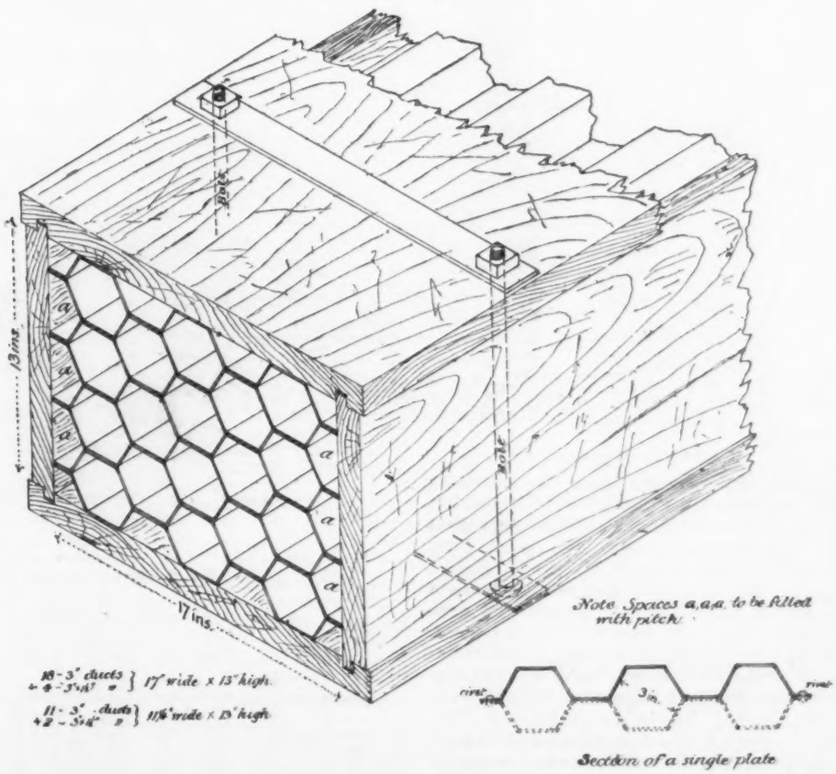


Fig. 4.

Fig. 1, shows a cross-section of the conduit laid in 1887 by the Electrical Bureau of the Department of Public Safety, and by several private telephone and electric light companies. It is constructed of creosoted hemlock 1¼ in. thick, the most usual dimensions being 12×12 ins. with nine 2¼ in. square ducts or compartments. These were originally filled up solid with pitch after the cables had been inserted, but as this prevented the withdrawal of the wires for repairs or renewal, the use of pitch has since been abandoned. Owing to the rude construction and generally rough surface of this conduit, cab le are easily damaged while being hauled through the ducts. The wood-work is also occasionally ignited by "leaking" wires, the resulting smoke belching from the manholes in such volumes as to suggest a volcanic eruption. The joints are easily penetrated by gas, and explosions with earthquake accompaniments have resulted from this defect. In one instance a cast-iron manhole cover 5×3ft. was blown skywards with such violence as to break several offending overhead wires as well as the windows in the vicinity.

Fig 2, is a cross-section of the new conduit now being laid by a local telephone company. It also is made of creosoted wood, but is of somewhat neater construction than the above described, the ducts being circular in shape, and possessing a smoother surface. A conduit of this description containing twelve 2½ in. ducts occupies a space 12×15 in. Manholes about 4 ft., 6 in. ×3 ft. and 5 ft. deep are placed at the intersections of streets and the wires thence conveyed to adjoining buildings.

The cast-iron conduit, Fig. 3, was laid a few years ago by an electric light company. It has not proved entirely satisfactory, owing to the entrance of moisture and gas through the joints, which are numerous, owing to the necessity of casting the conduit in short lengths. A recently patented conduit, of which I send you drawings, appears to overcome many of the objections to the cumbersome constructions, which up to the present have been adopted chiefly on account of the cheapness of the material of which they are composed. Plates bent into a corrugated or fluted form, as shown, are arranged in layers in such a manner as to render the whole of the interior space available.


13ins.
17 ins.
Note Spaces a,a,a, to be filled with pitch.
18 - 3" ducts } 17" wide × 13" high.
11 - 3" ducts } 11½" wide × 15" high.
3½
Section of a single plate.

Hexagonal Conduit.

PHILADELPHIA SUB-WAY CONDUITS.

The divisions between the ducts are at no point thicker than the gauge of the plates which form them, so that twelve 3-in. ducts can be obtained within a sectional area of about 13×11 ins. Full particulars of this patent can be obtained from W. C. CRANMER, Civil Engineer, 719 Sansom St., Philadelphia.

In contrast to the above mentioned design is the conduit shown in Fig. 4, formed of bored cedar logs. A cluster of twelve of these wooden tubes would need a space of 2 ft. ×1 ft. 6 ins. An illustration of this conduit appears on page 312 of ENGINEERING NEWS of April 21. Yours truly,

S. W. A.

[Our correspondent has admirably supplemented our description of the New York subways, and his description will no doubt be read with general interest.—ED. ENG. NEWS.

Locomotive Fuel.

EDITOR ENGINEERING NEWS:

Has there ever been invented a practical device for obviating the nuisance of smoke and cinders on passenger trains? Do you think the problem of preventing the nuisance referred to, with bituminous coal as a fuel, is worth the solving?

Do you think with our almost inexhaustible coal fields,, that petroleum has a chance to succeed coal as a fuel for locomotives?

Yours very respectfully, W. J. Y.

[There is no difficulty in using petroleum as locomotive fuel, and it has been so used for years in Russia with entire success. The fluctuations of price and uncertainty of supply exclude it from practical consideration in this country, unless for passenger trains, as to which the Pennsylvania and other roads have experimented, but not with such brilliant results as to make its use on a large scale probable. It is well worth anyone's while to solve "the problem of preventing the nuisance referred to"—if he can. No one has yet done so. The extended smoke box is an attempt in that direction. Anthracite fuel seems the only effective preventative of smoke, except to use coke, as is done on a large scale in England.—ED. ENG NEWS.]

A Peculiar Wash-Out.

DALLAS, Tex., May 18, 1888.

EDITOR ENGINEERING NEWS:

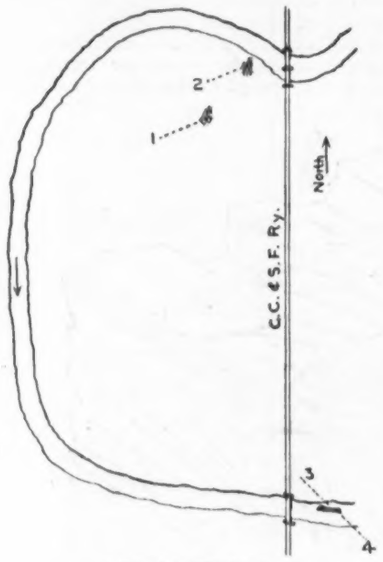
I send you herewith views, showing effects of a curiously effective wash-out on the main line of the Gulf, Colorado & Santa Fé Ry., something like a year ago.

The deluge swept away approach, embankments, track and bridges, depositing the fragments as shown in the views and the ground plan.

The bridges were first-class iron structures, having been up several years. The rise of the river was so sudden and high that it apparently lifted the bridges without injuring the masonry. One bridge, the southern one (Figs. 3 and 4), was apparently floated almost intact about 200 ft. The two spans of the other (northern) bridges were rolled over and over: one span (Fig. 2) about 600 yds. from bed of stream, out on the prairie. Yours truly,

JOHN N. OSTROM.

[The views are a curious illustration of the terrific force of floods, even in alluvial rivers having banks similar to those shown in the views at normal stages of water; and they also well illustrate how easy it is to make insufficient allowance for floods in such rivers. Except for the wrecks in the foreground, one might easily assume that, while the foundations of the piers were insecure, the trusses carried on them would be safe from injury,



A Peculiar Washout.

except by failure of the piers. Yet it appears that not only did the water reach them, but reached them with such force as to carry them the great distances shown. The span in Figs. 3 and 4, evidently struck the ground almost intact. The ties, track and guard-rails then separated from the floor proper, and were carried over bodily toward the upper chord, the floor proper (which is chiefly iron) remaining near the lower chord, where it shows conspicuously in Fig. 4, suggesting rather a fence in the cut as it does in the photograph. The wreck shown in Fig. 1, was floated off to such a distance from the track (600 yds.) that not a sign of it is visible in the photograph, although the camera was pointed directly toward it. Naturally, it was thought best after this experience to raise the grade, as shown in the temporary trestle.—ED. ENG. NEWS].

Round Timber Trestle, V., K. & Y. R. R.

VANCOUVER, W. T., May 8, 1888.

EDITOR ENGINEERING NEWS:

I enclose a photograph of bridge No. 2., now building on the Vancouver, Klickitat & Yakima R. R. across Burnt Bridge creek. The total length of the bridge or trestle is 662 ft.; greatest height, 65 ft.; bents 16 ft. apart. It does not differ from the average railroad timber trestle except in the plumb and batter posts, which are of round timber, cut in the vicinity, peeled, each post being one solid piece, of the full length required by the height. The foundation (mud) sills are hewn to a face 14 ins. wide and laid on a grillage of plank 4 ins. thick and 4 ft. wide, resting on hard gravelly soil, previously leveled to receive the plank. For the two center bents, 65 ft.

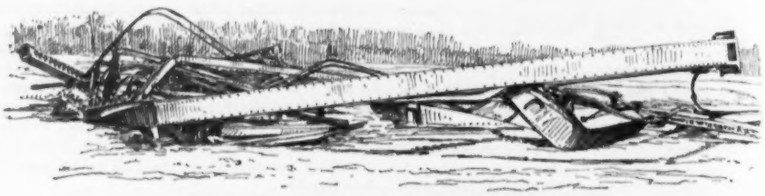


Fig. 1.—Wreck of South Span of North Bridge.

Fig. 2.—Wreck of North Span of North Bridge.

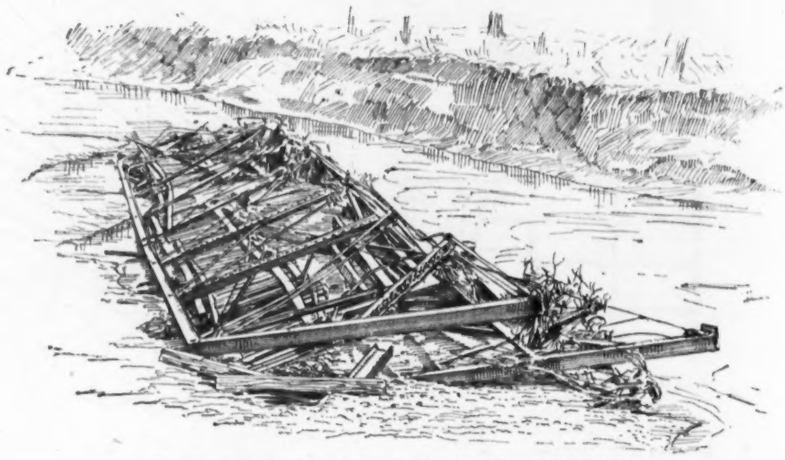


Fig. 3.—Wreck of South Bridge Looking From the Track.

Fig. 4. Wreck of South Bridge Looking Toward the Track.

A PECULIAR WASH-OUT.

[The point of view and the location of the wrecks relatively to the track are indicated on the sketch plan by numbers corresponding to the numbers of the cuts.]

high, the bed of the creek was excavated to a level bottom, and planked throughout, or rather floored, with 4 in. plank, on which the mud-sills were laid. All sway-braces are of sawn timbers, in size suited to position and duty.

The cost of the bridge (contract price) in detail is: Round timber, per lin. ft., constructed, 9 cts.; Sawed timber per M. B. M., constructed, $25; Iron, per lb. 6 cts. to 7 cts. Total cost of bridge, including foundation excavation, $2,400; $3.63 per ft.

This is a type of the bridges which will be built on this road. The abundance of round timber, of any desired dimensions, straight and sound, along the line of the road, secures great economy and strength. The item of posts and sills alone, if square timber had been used, would have cost 19 cts. per ft. for 8,000 lin. ft., over and above the actual cost, or $1,520 = 60 per cent. on the total cost of the bridge.

If you care for it, I will send you a drawing of the bridge for publication, or you can print the photograph enclosed, if you prefer.

Yours truly,
R. A. HABERSHAM, Engineer.

Round Timber Trestle over Burnt Bridge Creek.
Standard Type of the Vancouver, Klickitat & Yakima R. R.

[The engraving shows clearly the general type of construction, which is of course not only cheaper but better than sawed timber where suitable stock for the type illustrated can be found.—ED. ENG. NEWS.]

ENGINEERING NEWS.

A LINE of railway in Ecuador built by an American last year under a contract with the Government, at a cost of $500,000 is said to have proved so satisfactory that an American syndicate has been formed and a contract entered into for a line from Qhito to the Pacific, a distance of 126 miles, Congress authorizing the Government to guarantee the interest on the investment.

A DECIDEDLY novel locomotive is being constructed at the shops of ALBERT RUSSELL & SONS, Newburyport, Mass., for use on the Boynton Bicycle Railway. The inventor of this brand new system, E. MOODY BOYNTON, expects to attain a speed with his locomotive of more than 100 miles per hour. The railway has one track laid on the ground and another directly over it supported on a frame work. The locomotive and cars have wheels on the bottom and double trucks on top. By this, means the train "cannot possibly" leave the track, to attain which will certainly be in itself a remarkable achievement.

The length of locomotive and tender is 41 ft. over all; its greatest width is 44 ins. It has one driving wheel, 8 ft. in diameter. All the wheels are of cast steel, with heavy steel tires shrunk on, and the tires will have two deep flanges, so that the wheel cannot leave the rail. The cylinders are 14 × 12 ins. The boiler is 13 ft. long, 42 ins. in diameter, and has 96 tubes. The distance between the bottom and top rails is 16 ft. The cars are to be of steel and have a seating capacity of 100. It is expected that this locomotive will be ready for trial by August 1.

Engineering notes that the report of the directors of the Great Central Belgian Railway for 1887 affords some interesting data with respect to the working of the system. The directors state that favorable results have been obtained by the use of metallic cross-ties, the stability of the permanent way being perfect, while the cost of maintenance is sensibly less than that attending lines laid with wooden ties. The number of metallic ties laid down upon the Great Central Belgian system last year was 6000. The results attending the use of steel rails, as compared with iron rails, upon the Great Belgian Railway, are also increasingly favorable. The duration of the iron rails used upon the first establishment of the system was found not to exceed seven years. The use of steel rails was commenced in 1869, and the number of steel rails taken up as being no longer serviceable has been inappreciable, except upon the gradient between Lode-linsart and Marcinelle. The directors sum the matter up by stating that since 1869, 66.34 per cent. of the iron rails in use have been taken up upon the company's lines, while the replacements of steel rails in the same period have been only 0.96 per cent. The quantity of steel rails laid down upon the system last year was 1999 tons, as compared with 2296 tons in 1886. The quantity of iron rails used last year was 117 tons, as compared with 173 tons in 1886.

We wish such results could be more nearly paralleled in American experience.

A NOVEL method of loading steamers with refined oil will be introduced at the new refinery at Girard Point, near Philadelphia. From a tank there will run to the Schuylkill a pipe line to load the steamers with the refined oil. For this carrying trade, which it is proposed to bring to Philadelphia and which the officers of the company predict will be enormous in the next two or three years, the company is having remodeled a number of steamers. They will be exclusively for this traffic and will have tanks in their holds, into which the oil will be run through the pipe lines. Several of these large steamers now running between Bremen and New York carrying the crude oil in bulk will, it is stated, be chartered and will sail up the Schuylkill to the company's new wharves as soon as they begin active operations.

IT is stated that arrangements have finally been made between the Northern Pacific R. R. Co. and the Moss Bay Steel Co., of England, for establishing extensive steel works in Washington Territory. Work will begin soon. The iron company agrees to furnish traffic for a branch line to the extensive iron mines of the Upper Cle-alum river. It will take a year to construct the works, which will give employment for several thousand men.

THE cost of manufacturing steel rails at the EDGAR THOMSON steel works was in 1887, according to Mr SCOTT, per ton of 2,240 lbs., as follows:

One ton of Bessemer pig	$18.00
Converting	1.50
Blooming	.72
Finishing	1.87
1½ tons of coke	1.62
Estimated waste 13 per cent.	3.08
Total	$26.79

Of this $22.70 is for material and waste and $4.09 is for labor.

The selling price is between $31 and $32 per ton. The cost of steel beams, or structural iron is, on account of 30 per cent. additional labor expense, $28.02 per ton, and this Mr. SCOTT claims is sold at $66 per ton.

The number of skilled laborers employed and their average daily wages are as follows:

Converting department	228 men	$3.28	per day.
Blooming	81 "	2.81½	" "
Rail	126 "	3.02	" "
Finishing	119 "	1.99	" "

Average daily wages of all skilled laborers $2.58.

THE elimination of grade crossings in Buffalo and the construction of a Union depot appears now to be an assured thing. Active preparations are being made by the recently appointed Grade Crossings Commissioners. A Terminal Company is being organized by agreement of all the lines entering Buffalo (with one or two possible exceptions) to build the union station, pool the tracks, and arrange for their use by the various railways.

IT is reported by Superintendent HASKINS that, in a couple of weeks, work will be resumed on the Hudson river tunnel. On the New York side they have only succeeded in getting out about 900 ft., while on the Jersey side one tunnel is out over 1,800 ft., and the other one over 1,000 ft.

ENGINEERING NEWS

AND AMERICAN RAILWAY JOURNAL

Published Weekly at Tribune Building, New York.

VOL. XIX. Saturday, June 9 1888

D. McN. STAUFFER. A. M. WELLINGTON.

EDITORS.

GEO. H. FROST, - - - BUSINESS MANAGER.

Subscription. — UNITED STATES AND CANADA, $5.00 *per Year; $2.50 for Six Months; $1.50 for Three Months; Single Copies, 12 cents.* FOREIGN COUNTRIES, $6.56 *per Year, or 3 cents per number additional.*

Drawings and Photographs *of all new engineering works or designs, large or small, of interest from their magnitude, novelty or originality, as well as newly adopted* **Standard Plans** *for engineering structures or details, rolling stock, etc., are always desired for early publication. Also*

Brief Technical Notes *of the cost or manner of executing work, tests of materials, machines or other new devices, and* **News of New Construction** *of all kinds.* **Letters** *for publication must be accompanied by the name or card of the writer.*

Drawings for publication *should preferably be in plain black and white, considerably larger than they are expected to appear, with letters and figures in pencil only, all lines clean and bold.*

Coming Technical Meetings.

Master Car Builders' Association.—Next convention at Alexandria Bay, N. Y; commencing June 12. Secy., M. N. Forney, 45 Broadway, New York City.

Engineers' Club of Philadelphia Pa.—Regular meeting, June 16. Secy., Howard Murphy, 1122 Girard Ave.

American Railway Master Mechanics' Association.—Next meeting at the Thousand Islands, N. Y.; June 19. Secy. Angus Sinclair, Chicago.

Engineers' Society of Western Pennsylvania, Pittsburg, Pa.—Regular meeting, June 19. Secy., S. M. Wickersham, Penn Building.

Boston Society of Civil Engineers, Boston, Mass.—Regular meeting, June 20. "Stony Brook Dam, Cambridge Water-Works," by W. S. Barbour; "Quincy Dam," by L. A. Taylor. Secy., S. E. Tinkham, City Hall.

American Society of Civil Engineers, New York.—Regular meeting, June 20. Annual Convention at Milwaukee, Wis., commencing June 28. Secy., John Bogart, 127 E. 23d St.

Engineers' Club of Kansas City, Mo.—Regular meeting, July 2. Secy., Kenneth Allen, 19 Deardorff Building.

Civil Engineers' Society of St. Paul, Minn.—Regular monthly meeting, July 2. Secy., Geo. L. Wilson, City Hall.

Ohio Institute of Mining Engineers.—Summer meeting at Logan, O., July 11, 12, 13. Pres., W. H. Jennings, Columbus; Secy. R. S. Witzel, Kittanning.

Roadmasters' Association of America.—Next meeting at Washington, D. C., Sept. 11. Secy., H. W. Reid, Waycross, Ga.

WE shall publish in our next week's issue a general map of the United States showing in separate colors the new railways constructed in 1887, the corresponding construction for 1886 as per our last year's map, and the construction to date for 1888. This map will be accompanied by a complete list of the new lines of 1887 and 1888, summarized by States and systems, and also by diagrams, showing graphically the amount of construction in each State and on each great system. In connection with the editorial summaries, which will likewise appear, these data will give a clearer and more correct idea of just what has been done and is now doing in railway construction than can possibly be obtained elsewhere, and we believe that the record will come very close to absolute correctness, which is far from the case with the various statements which are rushed out immediately after the close of the year. By waiting a few weeks longer, as we have preferred to do, it is possible to make the 1887 record historically accurate, while at the same time giving the latest track-laying to date, so as to afford, an indication of probabilities for 1888. Those desiring extra copies of this map will do well to order early as the supply is strictly limited.

THE data in regard to the Panama Canal which we were able to present to our readers last week, the first really definite evidence yet published, have been abstracted and discussed in hundreds of papers throughout the country, as most of our readers will have had opportunity to observe, a very full abstract having been sent out by the Associated Press. As a rule, the conclusions expressed by the daily press have been substantially our own, that the prospects for the completion of the canal by the present company at least, even under the lock system, were very poor. The Washington *National Republican*, however, while pleasantly remarking that "ENGINEERING NEWS is an able and influential journal for whose opinions we have as a rule, great respect," goes on to declare that "on the Panama Canal question it is utterly irrational" and adds futher:

> The *National Republican* is not the champion of Lesseps or the Panama Canal. It has no relations with either. But it would like to see fair play. The Panama canal is one of the greatest pieces of engineering of this or any age. Its benefits are not to be computed in dollars and cents: they will be world-wide and perpetual. The door was open to all and we did not walk in. Now, shall we continue to unreasonably belittle the French because they did walk in and begin the enterprise which we neglected? ENGINEERING NEWS does not believe the Eiffel locks will be put in and does not believe therefore the canal will be completed. The Eiffel locks are being put in at this moment, or preparations made, which amounts to the same thing.

The *Republican* should have gone one step farther, and remarked that the canal was being opened at this minute, "or preparations made which amount to the same thing". Nothing could be a better illustration of the worldly wisdom of LESSEPS in wastefully concentrating his expenditure on the canal proper and in persisting up to the last moment in asserting that the sea-level canal was in a fair way for early completion, than the guileless way in which our daily contemporary forgets all about the Chagres problem, the dubious water supply, and the vast amount of work remaining to be done apart from the locks, and concludes that the only question is whether or not the locks will go in, and that as to them, "preparations made amount to the same thing" as having them in place.

It is hardly necessary for us to say that we have not the slightest disposition to throw cold water on the Panama Canal or any other great enterprise,—but we cannot ignore the fact that the Chagres river is not so considerate.

THE close observer who watches the course of events in financial circles has reason to be continually astonished at the wonderful wealth producing power which exists at the present time, as evidenced by the enormous amount of capital continually being invested in permanent enterprises. About $50,000,000 to $60,000,000 worth of bonds were sold by American railway companies during the first three months of the year, and it was thought that the surplus capital of the country had been largely taken up, so that future loans would be apt to go slowly for some time. But recently the Baltimore & Ohio loan of $7,500,000 was taken by London capitalists before New Yorkers had come down-town to business; the Canadian Pacific bond issue of about $15,000,000 was subscribed for in London ten times over; and the $24,686,000 of new Reading bonds, which were opened to the public for subscription on June 6, simultaneously in London, New York, Philadelphia and Boston, were taken within a few hours with a large amount of extra subscriptions.

It is to be borne in mind that all these bonds bore interest at low rates, 4 or 5 per cent. There is a great abundance of capital whose holders are anxious above all else for safe and sure returns for a long term of years. The rates of interest tend downward as the supply of available capital grows greater, and the opportunities for its profitable employment grow less. With this state of affairs there is no reason to apprehend any long continued season of business dullness. Projectors of honest enterprises which promise sure returns, even though small, have no trouble in finding capital for their work and at such rates as make permanent and durable work cheaper than short lived and temporary structures. It is a fortunate fact, all things considered, that investors are so much in the majority over speculators, so that the bond market is active while the stock exchange is dull. The prosperity that comes from the furtherance of hazardous enterprises promising much and yielding little, brings soon the reaction of dull times; while the amount of capital engaging in enterprises for which there is an actual need can never be too great for the country's prosperity.

THE Paris *Temps* gives some details of M. HERSENT'S great project for a Channel bridge, which can at least be read with interest although they may not be read with general acceptance. M. HERSENT, we may note, is a very prominent French engineer and contractor, ex-President of their Society of Civil Engineers and one of the great firm of contractors which undertook to build the Panama Canal some years ago, and then concluded not to, being paid a large sum to cancel their contract. His great bridge, when built, will have 60 spans of 500 metres each (1640 ft.) or be some 18.6 miles long in all; will be 50 metres above the sea; 4 tracks, with road and foot-ways; will contain 2,000,000 tons of metal and will cost $160,000,000, or $80 per ton; a price at which, by the way, if M. HERSENT is prepared to take contracts generally, he can very easily monopolize the bridge-building of America and pay duties beside. The foundations are to be pneumatic of course, and the depth of water ranges from 25 to 39 metres; in a few places 50 metres. Six years is allowed for construction.

The above cost amounts to $2,666,667 per span for 33,333 tons of metal per span. The Forth bridge, which we may consider practically as three spans of 1700 ft. each (5330 ft. in all), with foundations only about half as deep, carrying only two tracks, and not quite so high above the water, contains about 50,000 tons; and was originally estimated to cost $8,000,000, or $1,500 per lineal foot, while it will actually cost some $12,000,000 or $2,250 per lineal foot. M. HERSENT'S allowance amounts to $1,620 per lin. ft., and while there is considerable discrepancy in the weight (20½ tons per lin. ft. against less than 10 tons on the Forth bridge) it certainly would not be necessary to have any such difference in practice under the stated conditions; and bearing in mind that a large part of the cost of the Forth bridge is for special plant and facilities, which are a heavy charge on the three spans but would not amount to much distributed over 60 spans, the experience of the Forth bridge would rather seem to support than to controvert M. HERSENT'S conclusions.

THAT it is any longer beyond the resources of practical engineering to bridge the channel we do not believe; practically speaking, we have only to multiply the Forth bridge by 20

and it is done. Whether it will pay is another question, but the Forth bridge is being built for a comparatively trifling traffic which is already fairly well provided for, and assuredly there is much more than twenty times as much traffic in sight between England and the Continent as there is for the Forth bridge. At 4 per cent. the interest on $160,000,000 would be only $6,400,000; and at twice that cost, which would be a much safer figure to assume, the enterprise ought to be able to justify its existence.

It is stated that the project is soon to be submitted to an "International Technical Committee" and that then a concession will be applied for to the French and English Governments. The consent of the latter will be hard to obtain. The "national defense" question will not be nearly so serious as with a tunnel, because a shot or two from any man-of-war would at once break communication, and this safeguard would be in addition to the terminal protection works in respect to which both bridge and tunnel stand on a par. Still a solid connection with the main land of any kind will be sure to meet with a good deal of conservative opposition, besides that resulting from such sapient comments as an "M. Inst. C. E." sends to *Engineering*:

"If this bridge, or any like it, be ever built, woe to the port of London: it and all other ports above the bridge would soon be abandoned."

Such nonsense can be compared only with the still more confident predictions that the introduction of railways would destroy the demand for horses, but there will be a good deal of it aired before a concession passes through Parliament, and appalling pictures of the tunnel seized and 100,000 men rushed over in an hour by working all four tracks in one direction, will be sure to be drawn.

A discussion is going on in the English engineering journals which illustrates better than any direct evidence could, under what different conditions locomotives are operated here and abroad, especially in passenger service, and hence how valueless and misleading are the comparisons of fuel burned per train mile, which undoubtly averages higher in this country. Here the great question is whether to use 4-driver or 6-driver engines for passenger service, and many roads are using the heavier type, while no one thinks of using the single axle type, a dozen or so engines for specially fast service and light trains and grades excepted. In England the question now raging is whether "single or coupled locomotives" are best for general service. Some roads prefer one and some the other, and *The Engineer* lays down the law that "so long as the maximum hauling effort of a locomotive does not exceed 4 tons, single driving wheels will answer well. If the pull exceed 4 tons, then the wheels should be coupled".

Precisely what *The Engineer* means by "maximum hauling effort" is not apparent; but if it means what it says, the maximum hauling effort which the standard type of 4-driver "American" engine, 17 x 24 ins. cylinders, is up to is about 6 tons, and it is found too light for our express service, while the lightest "American" engines now in use, 14 x 24, are equal to a pull of 5 tons, although of course not at high speed. At high speed, however, no engine is equal to a pull of 4 tons or 3 tons, nor is it required, the average traction at 50 miles an hour with trains of 9 or 10 cars weighing 300 to 350 tons being only 2800 to 3000 lbs.

The Engineer, on the whole, leans to the single type, up to a maximum grade of 0.4 per cent with 130 tons behind the tender at an average speed including stops of 44 miles per hour. The last is very high speed, which few lines here can even attempt to touch because of grade crossings, passages through towns, etc. If we were able to make such speed otherwise, our trains would certainly be lighter, because they would have to be. We are not claiming now any superiority of practice in either country, however, but simply pointing out how different the conditions are.

OUR surmise in discussing "Natural Gas and Oil", in our issue of April 14, that the supply must be a strictly limited quantity, and that perhaps the greatest benefit from it in the end would not be the direct saving of fuel from burning it, but the stimulus it would give to the introduction of artificial fuel gas, is in a measure supported by the last report of the great "Philadelphia Company", of Pittsburg. They do not say in so many words that they have any reason to fear early exhaustion of the supply, but actions speak louder than words in such matters, and they do say:

"The prodigious growth of this business has caused the managers of your company to anticipate the time when they will be compelled to supplement the natural supply by the addition of manufactured gas, and they have united with the "Fuel Gas & Electric Engineering Company" Limited, of Pittsburg, in experiments to secure the best results, thereby acquiring for the Philadelphia Company the right to the exclusive use of the Fuel Gas Company's system in Allegheny county."

The income last year was $1,901,703 against $1,500,161 the year before, with expenses of 46.65 per cent. (35.60 per cent. *ex* rents) against 65.65 per cent. (55.75 per cent. *ex* rents) a year ago. It is apparent, therefore, as we said formerly, that "even when gas is obtained for nothing from a hole in the ground there is a good deal of expense attending the mere handling of it". As one item, the pipeage, now covers 654 miles, all but about 250 of which is 8 to 30 ins. diameter, against 412 miles a year ago. The number of wells has increased from 62 to 112, and the dates of drilling these wells are significant, viz.

1878	1882	1883	1884	1885	1886	1887	1888 (3 mos.)
1	1	5	7	14	30	41	13

A steady increase of supply is necessary for the increased demand but hardly to the extent of a jump from 62 to 112 wells. We should be compelled to suspect that the endurance of the supply was dubious even if the company did not confess as much. We can only hope it will last a long time and that the artificial substitutes will effectively take its place and become universal.

WE learn that the statement which has been quite extensively copied, and among other places appears at the bottom of p. 490 of Mr. WELLINGTON'S "Economic Theory of Railway Location", that the heavy pile-driver car of the Georgia Central Railroad is able to drive piles to 18 ft. below the rails, is not true. The company at one time had in use an arrangement for splicing the guides to enable it to drive to 18 ft. below the rails, but it was not altogether satisfactory. The pile driver now in use on that road does not work on the drop principle at all. It is a steam driver, and the blow is struck by the piston, to which the hammer is attached. The cylinder in which the piston works is mounted on a frame which slides up and down the pile-driver guides. When the machine is at work this frame rests on the head of the pile and follows it down as driven. It is of sufficient length to reach about 8 ft. below the rail and this is the vertical limit of work, but piles can be driven on either side at a distance of 18 ft. from the track.

THE article on Siberia, by Mr. GEO. KENNAN, in the current *Century Magazine*, gives some interesting details about this vast and little known area, which have a direct bearing on the vast project for a 5,000 mile railway across it, which we noted last week, later reports in regard to which are that the first division of 2,800 miles is to be speedily begun, and that the total cost of line is estimated at 400,000,000 roubles. The par value of the rouble is 75 cts., which would make the average estimated cost $60,000 per mile, but the depreciated paper rouble, in which the estimate is probably made, has a value of only 50 cts., or less, which would make the estimated cost $40,000 per mile. As Mr. KENNAN puts it in his article, Siberia is large enough to put down the whole United States within it intact, and still have room around the borders for Alaska and the whole of Europe, except Russia, with 300,000 sq. miles to spare. Its western end extends as far south as Cuba, and the most northerly portion of its southern boundary is not much farther north than London. Like all areas situated far from the sea the extremes of winter and summer temperature are great, but "in the fertile and arable zone of southern Siberia, which is a belt of country 400 or 500 miles wide, there are a dozen towns which have a higher mean summer temperature than London, and the average of the whole belt is 6° higher than the average of England". Many further details as to the agricultural wealth of this region are given, which we cannot attempt to abstract, especially as everyone ought to read the article for himself; but they certainly seem enough to prove that the great railway project is a sound one from a merely commercial standpoint, while its effect in opening up the whole of Asia to modern civilization would certainly be great. The recently opened 885 miles of line to Samarcand, in southwestern Siberia, will, in itself, have no slight tendency in this direction, since it brings the railway close to the western frontier of China. That Siberia is even now anything but given over to barbarism is evidenced by the fact that at Tiumen, the principal forwarding point for exiles, nearly 2,000 miles east of Moscow, there is a technical school, "similar in plan to the Institute of Technology, in Boston", which compares with it not unfavorably in buildings and equipment, and it is not a Governmental institution either, but was founded by a private citizen.

WE have received in all $78 in seven subscriptions for the family of the late W. R. KUTTER, of Berne, Switzerland, author of Kutter's formula and conductor of the extensive hydraulic experiments on which it rested, viz:

John C. Trautwine, Jr.	$20
Rudolph Hering	20
Gustav Linderthal	5
Stephen H. Emmons	10
Frank S. Hart	3
J. T. Fanning	10
Engineering News	10
Total	$78

We hope the engineers of the country will open their hearts and their pocket-books a little wider, and shall expect them to. This is really a deserving case from every point of view, and it should not be forgotten that every subscription is doubled or tripled in effect by the fact that the money is given here to be spent in Switzerland. Some little recognition of eminent and faithful services to the cause of science is a graceful act in any case, but when it relieves real necessities in addition, it is one which every engineer who is fairly prosperous himself should regard as a duty as well as a pleasure.

REPORTS from Nicaragua abstracted elsewhere show that the surveys are completed, and with "favorable results." When there is something more definite we shall hope to present it to our readers. Other reports state that four miles more of slack-water navigation in place of excavated canal have been secured, leaving only 36 miles of canal proper.

Good and Bad Standards.

The Master Car Builders' Association, which holds its annual convention next week, has become a most important body, whose real character is hardly indicated by its title. Unlike the Master Mechanics' Association, which holds its meeting the following week and confines its proceedings almost wholly to the discussion of technical questions, the Master Car-Builders' Association has as its chief excuse for being the great practical question of regulating the vast system of freight car exchanges, which involves great interests, and indefinite opportunities for controversy and dispute which the M. C. B. Association has done much to lessen.

The work of the Association to this end takes two forms. The first is the direct one of formulating rules for the interchange of cars, which are revised each year to meet changing conditions and advancing experience, and which now include a list of 31 well studied rules which provide for every ordinary possibility. The rules, when formulated, are not binding unless accepted by each company, and formerly a good deal of trouble and confusion used to arise from companies saying that they "accepted the rules except" such and such a one that did not happen to suit them. But this was put an end to three years ago by a clause stipulating that acceptance or rejection must be as a whole, and no such exceptions should be valid, and practically acceptance of the rules is obligatory on every company as the only escape from endless dispute, and possibly, now that the official character of this work is so well established, a refusal to interchange cars at all. Naturally, the companies, are careful to ensure that they have a voice in the formation of the rules.

The second mode of facilitating interchange has been by the establishment of standards for various parts of cars. Except for the practice of interchange there would be no particular motive for seeking uniformity of practice, and each road would be left in peace to follow its own notions, as they were anyway until ten or fifteen years ago. But it is obvious that, with cars going anywhere and everywhere all over the country, so that on many roads more than half the cars are foreign, and with many cars away from home for months or years together, not only was the expense of repairing them greatly enhanced by irrational diversity but the dangers to trainmen in coupling and handling cars were also much enhanced. Diversity went so far, for example, that the Erie road kept regularly in stock, and probably still does, 46 different forms of draw heads, of 20 or 30 different widths and depths and lengths, for which there was no other reason or excuse than that each car-builder was following his own notions regardless of all others. A like diversity existed in axles, trusses, journal boxes, brake-gear and what not, so that to avoid endless trouble and expense, tens and hundreds of tons of foreign castings were kept on hand, of all sorts and descriptions, to repair the appropriate cars as they came along.

But, as is natural when confronted by such senseless irregularity, the Association has been led in some respects to go too far, and in one at least of its standards is probably doing positive harm. The tendency has so far been unbroken, whenever a standard was established at all, to establish only one standard for the entire United States. In some cases, as notably for the height of the drawbars and automatic couplers, this is inevitable. The standard must be absolutely uniform and general, or it is no standard at all; but in other cases, while it is perfectly natural to say, as has been said in all cases, "Come, let us have done with this senseless diversity in axles and drawbars and brake-shoes, and have only one form of each on the continent", it is more than questionable whether it is either sensible or wise to do so. It is hardly sensible, because absolute agreement for which a necessity is not apparent is practically impossible; and it is certainly not wise whenever, as in the case of axles, some limited range of choice is desirable to suit the different conditions. Every desirable end is as fully accomplished in a practical sense by reducing dozens or hundreds of diverse forms to two or three, from which any one is at liberty to choose, as to attempt to make every one accept one standard or none. In the first case, agreement within the limits of choice allowed is practically certain; in the other case, as the experience of the Association has abundantly proved, it is practically impossible.

Of the standards adopted by the Association, there is a long list which are thoroughly good and necessary, because for them uniformity of practice is the first essential. The most important of these is the latest one, the adoption of the "Janney type" of automatic freight car coupler. The Association cannot be said to have distinguished itself particularly in its handling of the great coupler question, since it was in a measure forced into its final action by the formation of an outside Committee, representing some 30,000 or more miles of line, which proposed to settle the matter independently of it, and but for this outside action the Association would perhaps have delayed its own much longer; but it was a question involving many difficulties, and the considerable delay was excusable, while the final outcome was all that could be desired. Next in importance and value, perhaps, are the standard dead-blocks (adopted 1882, and modified 1884 and 1886); the standard distance between backs of car-wheel flanges, 4 ft. 5⅜ in. (1883, with a ¼ in. variation either way in 1885), and a series of freight car standards aimed at the protection of train-men (1879) fixing the position of brake-shafts and attached parts and the position and form of the steps, ladder, grab-irons and running board on top of the car. Still more important was the fixing the height of freight car draw-bars at 2 ft. 9 ins. from top of rail to center of draw-bar, which has almost put an end to the extreme diversity which before existed, and would have done still more to that end except that the important question of whether the measurement was to be made when the car was empty or loaded was left unsettled until 1884, many roads having adhered in the meantime to diverse practice, as they still do. A standard height for passenger draw-bars, 3 ft., was also early adopted, and has been fairly well observed. All these standards were highly important for safety and economy of operation. Others of great importance for shop economy, in which absolute uniformity was likewise highly important were the standard (Sellers) system of screw threads (1872), the limit gauges for round iron (1883; allowing only .01 to .02 in. variation instead of the wide variations which had before been common); and a set of nine standard wheel and axle gauges (1882).

Still other standards of a less important nature, but which in their tendency are wholly good are a system of lettering "line cars" (1884) and a considerable list of standard dimensions for freight draw-bars, not extending to the point of a standard type of non-automatic draw-bar, which would have been almost hopeless, but doing a good deal towards it, and greatly simplifying repairs.

In all, this makes a list of 15 standards which have accomplished great good already and are likely to accomplish still more, and which are not likely to ever need any important modifications because of different future conditions. To this might fairly be added the practical establishment of a standard type of freight train-brake; the most thorough and valuable piece of work which has ever been done under the auspices of the Association, since it was done not simply by resolution and vote, but by a practical demonstration in an exhaustive series of experiments of what was and what was not good practice.

But good as these standards are, it still remains true that quite a number of them are more honored in the breach than the observance, and of a much shorter list of more dubious standards this is still more emphatically true; of some of them it may even be hoped that it will continue to be so. The Association lays its standards somewhat as an ostrich lays its eggs; lays them in the sand and leaves them thereafter to take care of themselves, without further oversight. No human being knows to what extent each of these standards is in use, even approximately. Some are known to be very little used, and some to be very widely used, but if regular reports were collected of the extent to which each were used, or neglected, and the reason therefor, as might easily be done and is plainly desirable, there can be little doubt that it would lead to modifications of some of the standards and perhaps to the entire abolishment of others.

For example, there are probably in use today in the United States and Canada 20 or 30 different forms of brake-shoe and brake-head; perhaps twice that number if we count all those as different which will not interchange with each other. The appropriate committee readily agreed on three different forms, and finally on two, as preferable to the others, nor can it be reasonably claimed that either had material advantages over the other. Had the Association standardized each of these, and left every one free to choose between them, there is no reasonable doubt that roads using no one of them would speedily have accepted one or the other, since they would otherwise have been in a small minority, while no road would feel it a hardship to keep a small stock of each standard in hand for repairs. This was not done. The effort to agree on only a single standard was pushed until finally a two-thirds vote was obtained for one (the Christie). But this does not mean that the very roads which voted for it will use it. On the contrary, some of the largest roads have other styles in use in immense equipments, and have not and will not change. Hence, those using the "standard" are and are likely to remain in the minority, and this *unauthorized* diversity will encourage still more of it. That this is true is proved by experience with four much older standards; the standard journal box, journal bearing, and journal box pedestal. They have been in force since 1874, but they are still very far from being in general use. The journal bearing is making very good progress in that direction, but the pedestal and box are much varied from.

The same is still more true of the "standard axle", 3¾ x 7 ins. journals, adopted in 1873. It was the result of a compromise between those who wanted a large journal and those who wanted a small one, and it suited neither perfectly. It is decidedly too small for many of the heavier modern cars, which have 4 x 8 journals quite generally, a size actively urged as a standard for all cars in 1872-3. On the other hand, it is quite certainly larger than is necessary for some of the cars built for lighter service to-day, and even if it were not, practical agreement on any large axle is impossible when smaller sizes answer very

well. Had a large, a small, and a medium-sized standard been adopted in the beginning, one or the other would by this time be in universal use. Every practical end would have been subserved, and by survival of the fittest a single standard might in time have resulted if it was in fact desirable. It is more than doubtful, however, if it is desirable. It is to be remembered that the weights and loads of cars differ greatly. On some roads and for some cars heavy loads are almost universal; on other roads they occur so rarely that they need never be provided for, and there is something very absurd to engineers in even attempting to enforce uniformity in car axles carrying such different loads as 10, 15, 20, 25 and 30 tons, when there is room for legitimate difference of opinion as to the proper size for any one load. Far better and more practical it would be to have three standard sizes of axles, and allow every one to choose between them according to his requirements or his notions.

Finally, the standard wheel tread (1886) differs from all the other standards in being an attempt, not to average past practice but to change it, by using a sharper corner radius, and so approximating the wheel tread more closely to the form of the rails. It is more than questionable if it is desirable to do this even if it be possible. A committee of the American Society of Civil Engineers has the matter under consideration and will shortly report, so that we will not attempt now to discuss the matter, but in shortening the radius of the fillet or inner corner of the flange from the $\frac{3}{4}$ in. or more which was previously most common to $\frac{5}{8}$ in. (some urged $\frac{1}{2}$ in.) we suspect that the Association has done positive harm, besides wasting its energies in an effort at a "fit", which even if secured lasts only a few months. All that is really necessary, in all probability, is that the fillet radius shall not be less, and preferably considerably larger than the corner radius of the rail. The contrary should have been made clear before definite action was had in regard to it.

But there are few men or bodies of men whose actions are always or in all things wise, and the good which has been done by the M. C. B. Association so vastly outweighs the bad or the doubtful that there is probably no voluntary organization in this country which can point to so honorable a record.

PERSONAL.

J. J. CASEY, Master Car-Builder of the Mississippi Valley R. R. at Vicksburg, Miss., has been appointed Superintendent of Motive Power of the road, to succeed E. D. EDWARDS, who has resigned. His headquarters will be at Memphis, Tenn.

W. F. RANDALL, of Oneida, N. Y., has been appointed Engineer and Surveyor for the corporation of Gloversville, N. Y.

HENRY L. COLLIER has been elected Superintendent of the Atlanta & Florida railroad, which is now open for business from Atlanta to Culloden, Ga., 76 miles. Mr. COLLIER has been Chief Engineer of the road since its construction begun.

JAY GOULD has been on a tour over the northwestern lines of the Missouri Pacific system and reports of his serious illness while on the trip have been widely circulated. It is probable, however, that the rumors have small foundation in fact. Mr. GOULD'S health is a favorite subject for stock jobbing romancers.

WILLIAM L. BAKER, Superintendent and Engineer of the Detroit Bridge & Iron Works, died on May 28 at Detroit, in the 38th year of his age, after a gradual failure of health for the past three years. He was a graduate of Troy in the class of 1871, and almost immediately entered the service of the company in which he continued to his death. He was married in 1879 and leaves a wife and two children, as well as a host of warm friends in all parts of the country. Active, capable and energetic, his administration was not only successful in a business point of view, but made him known as an individual to a large circle which will sincerely mourn his loss.

Boiler Explosions in 1887.

The following summary of English boiler explosions for the last 15 years and the details of explosions in 1887, which follow, are taken from *Engineering*:

Year.	Number of Explosions.	Number of Persons Killed.	Number of Persons Injured.
1873	78	57	85
1874	76	77	198
1875	68	81	142
1876	62	93	110
1877	44	54	75
1878	46	47	84
1879	30	38	53
1880	31	71	83
1881	33	41	51
1882	38	38	43
1883	39	21	41
1884	32	22	48
1885	38	30	52
1886	36	31	70
1887	36	24	42

Remembering that the number of boilers in use has been steadily increasing, the continued tendency to improvement is very notable.

Besides the 36 boiler explosions for the year 1887, which appear in the table, there were 21 explosions of heating appliances, etc., not strictly steam boilers, resulting in 17 deaths and 8 injuries.

Of the 36 explosions occurring in 1887, 8 of the boilers were used on ships, 5 on farms, 3 in collieries, 3 in iron works, 3 in spinning mills, and the remaining 14 in various places.

The causes of explosion were: Faults of construction which may be detected before starting, 8 failures, including 3 from weak tubes, 3 from seam rips or old cracks, 1 from weak box and 1 from bad repair; faults of inspection 14, including 11 from external and 3 from internal corrosion; faults which may be detected by attendants 14, including 5 from low water, 5 from salt and scale, and 4 from over pressure.

Of the 21 vessels, not properly steam boilers, which exploded, 9 failed from over pressure, 4 from scale, 2 from external corrosion, 2 from bad pipes, and the others from various causes.

The types of boilers which failed were Cornish or Lancashire, 9; plain cylinders, 4; multitubular, 8; small vertical, 9; marine, 5, and Rastrick, 1.

ADVANTAGES OF DIFFERENT STREET PAVEMENTS.—The following is from the report of WM. STEYH, City Engineer of Burlington, Ia.: Granite block; Service very good, durable, needing little repair, free from dust, very noisy, slippery when worn, especially on steep grades. Cost per square yard $4.00.——Asphaltum: Service very good, free from noise and dust, but not very durable in our severe climate, and expensive to repair. Cost per square yard, $3.00.——Wood block; Service very good during the first three years, free from noise and dust, but unhealthy after the wood begins to decay. Cost per square yard, $1.50.——Brick; Service very good, durable, needinglittle repair, free from noise and dust and easily repaired, but slippery on steep grades. Cost per square yard, $1.65.——Macadam; Service reasonably good, but very muddy in wet and dusty in dry weather, needing constant repairs where traffic is heavy. Cost per square, yard 75 cents. The following is the approximate cost of the above mentioned pavements per foot front exclusive of cost of curb:

Granite	$12.00
Asphaltum	9.00
Wood	4.50
Brick	5.00
Macadam	2.65

A snow tunnel has been cut through a big pile of snow which slid off the mountain between Ouray and Silverton, Colorado, last winter which, it is expected, will last all summer. It is 200 ft. long with open approaches cut through the snow bank for about 100 ft. and is under more than 50 ft. of closely packed snow.

IT is said that ruins of great magnitude and interest have been discovered by a surveying party near Janos, in the State of Chihuahua, Mexico. A row of dwellings extends for miles, built up in terraces with solid masonry. The front walls of these houses are of hewn stones, carefully cemented together, while the backs are built into the sides of the canyon. These ruins are remarkably well preserved. In another place, on the top of an isolated mountain, there is a gigantic stone structure, while at the base a series of terraces, very substantially built, give evidence that at some time an extensive system of irrigation must have been in operation. Many stone tables, pestles, hammers, and household utensils are found, and occasionally bronze tools of a temper and hardness almost equaling modern steel tools.

Salaries of Engineers in India.

The comparatively low salaries of engineers and surveyors in India have already been commented on in these columns, the rupee being translated into its gold value of 36 cts. It seems that the depreciation of the rupee from 48 cts. to its present value of 34 cts. has been a cause of grievance to young engineers who were induced to go to India by promised salaries of 4,200 to 5,400 rupees which they supposed would be equivalent to $2,000 and $2,500 per annum, but which they find are now only worth about $1,400 and $1,800 respectively.

The actual salaries paid in the Government Service, considering the rupee worth 34 cts. are as follows:

	Salary per Annum.
Chief engineers, first class	$10,200
" " second class	8,160
" " third class	7,344
Superintending engineers, first class	6,528
" " second class	5,508
" " third class	4,488
Executive engineers, first grade	3,876
" " second grade	3,264
" " third grade	2,652
" " fourth grade	2,244
Assistant " first grade	1,836
" " second grade	1,428
" " third grade	1,020
Apprentices	408

The brilliant prospect which young engineers saw before them has not been realized. Promotion has been retarded, partly by the reduction of expenditure on public works, and partly by the inability of senior men to retire owing to the depreciation of the rupee and the consequent reduction of their pensions. Unless some relief is found, numbers of men will have to retire before attaining the rank of superintending engineer (which would entitle the holder to a pension of $1,700 per annum) on a pension of 4,000 rupees, which is at present equivalent to about $1,350, and is likely to decline still further. This cannot be called a brillant outlook for men who have passed a stiff competitive examination and undergone an expensive technical education. But then in getting a pension of any kind the East Indian engineers are better off than most others.

The Bayonne, Anglet and Biarritz Railway.

The Engineer gives a description of this light railway and the compound locomotives in use, with illustrations of the somewhat peculiar double-deck car used. The road is built to standard guage, and has steel T-rails 26 ft. 3 in. long, weighing 45.5 lbs. per yd. The rails are laid on unprepared pine cross ties 30.45 ins. between centers, and are inclined 1 to 20, the inclination being obtained by the bearing on the ties.

This road was the first to use compound locomotives, and it has five, three for light traffic, with four wheels coupled, and two with six wheels coupled for heavy traffic. These locomotives can be used compound or non-compound, the object being to vary the power at will rather than economy of fuel. The decided advantage of this arrangement where the train resistance varies considerably has been clearly proven on this line, and the same system has since been adopted on other roads. It permits a quick start, safety in running, and avoids the necessity of stopping when the steam pressure is reduced below the point where compounding can be done advantageously. The weight of the heavy locomotives is 24.5 tons, all of which is available for adhesion. The small locomotives weigh 19.6 tons.

A novel car of very great carrying capacity is used, the double-deck style being adopted, as no limit to the height of the car is imposed by overhead bridges. There are three classes of these composite cars; one for first, second and third class passengers, the latter being on the upper deck; another for second and third class passengers and baggage, one of these cars sometimes forming a complete train in winter, or when the traffic is light; and the third-class cars with the upper-deck open. These cars are 21.3 ft. long; 9. 84 ft. wide, and nearly 17 ft high, it being

10 ft. from the top of rail to the floor of the upper compartment. The wheels are 2.95 ft. in diameter, and the wheel base is 12.3 ft. The capacity of a third class car is 90 passengers and the total weight is 19,800 lbs., a dead weight of 220 lbs. per passenger.

The length of this line is about five miles, and the running time is 14 minutes. No intermediate stops are made, save one in the middle of the line for passing trains when two are in use. The fare is, single trip, 14.6 cts. first class, 8.73 cts. second class. The gross receipts for 1885 were about $56,000 or $11,000 per mile. The total expenses were about $28,000 or $5,500 per mile. The total number of passengers was 724,235, of which only 35,535 were first-class; these passengers were carried in 14,956 trains, an average of 49 passengers per train and 41 trains per day. The greatest number of trains per day was 54, the least 32; the highest number of passengers per day was 7,545 (in 1884 it was 12,992), and the lowest 590. The fuel is Cardiff coal, and the consumption was 5.72 lb. per mile.

Twenty Years of Open Hearth Experience.

The following is a resumé of a paper read before the Engineers Society of Western Pennsylvania by W. E. KOCH, Manager of the Spang Steel & Iron Co., containing much interesting information for those concerned with the working and use of steel. The paper is about twice as long as our abstract, but we have endeavored to preserve all the most valuable matter.

In 1867 the first open hearth furnace known in England, of any size, was built at Crewe. Before that there was a little open hearth furnace built in the back yard of a house in Birmingham, where experiments were made by Dr. SIEMENS, and in which he used to melt about a ton at a time.

In 1869 sand bottoms were believed to be bad and basic ones were tried, at the suggestion of a French metallurgist. Magnesia, lime and dolomite were tried. Theoretically this should have done wonders; but practically it was a failure and was abandoned for the sand bottom still in use.

During this year Landore was started, also the Steel Company of Scotland. Every conceivable form of furnace was tried except the circular. The generators were put on top, at the sides and in the bottom. Great difficulty was found in holding the brick together. Silica bricks were not so well made as at present, and expanded frightfully, so we allowed the furnace to expand in all directions only trying to keep it from falling to pieces. Now-a-days we are not surprised at 500 or 600 heats without repairs; but in those days five or six heats without repairs was something remarkable. The heat was liable to come out at the sides, and indeed any place but the top hole, or the roof would tumble in just as the steel was ready to tap.

In 1872 a lining composed of 54 per cent. aluminum, 42 per cent. oxide of iron and 4 per cent. of silica was suggested; but we could not mend it.

Another difficulty was in the materials; 20 per cent. manganese was considered high, against 70 and 80 per cent. now at our command. The first we made contained only 5 to 10 per cent., and the result was high carbon and irregular results, say .40 per cent. carbon in one heat, and .20 per cent. in the next. Anything below .22 per cent. seemed to us soft as lead.

Two new processes were started in 1870, the first being the Siemens-Martin, consisting in the introduction of scrap into a bath of pig. It was worked in two ways; first, charging pig and scrap together, and second, heating the scrap separately and introducing it into the bath after the pig was melted. The latter saved the bottom a great deal. Punchings and drillings were always kept handy for stopping holes and keeping in the heat.

Then Dr. SIEMENS in conjunction with MR. ARTHUR WILLIS started the ore process, using little or no scrap, and substituting ore to boil the metal down to pitch. This was a good process in its way; but the slag accumulated on top and made trouble by cooling the bath; or our men would tap it all off and waste the steel by increased oxidation, accompanied by excessive wear of the furnace lining. After a bit we found by using two-thirds ore and one-third scrap we got good results. That was the beginning of the success of the process. All the regular product of Landore during 1875-6-7 was made in that way. We finished with a good ore like Malta or Spanish. Then we found that silicon in the furnace made the steel more quiet in the moulds. We used a pig containing 3.0 per cent. carbon, .03 per cent. sulphur, .30 per cent. phosphorus, 3.0 per cent manganese and .85 per cent. silicon for the bath and added a spiegeleisen which contained 50 per cent. manganese. After the silicon process was discovered, we were inundated with patents on nitre, oxide of lead, chalk, fluorspar, clay, sand, magnesia, etc. The nitre was very successful in making a hole in the roof.

One of our earliest successes was to convert iron rails into steel rails. The iron rails were double head and averaged phosphorus .3 per cent., pretty good iron for that time. We charged 4½ tons of iron rails and 3 tons of hematite pig, melted them down in the furnace, and when it came to a pitch we used a little ore, about 700 lbs. to the heat, and added ¼ per cent. of silicon pig and .63 per cent. of ferro manganese. The result was an excellent rail, with the analysis; carbon .20 to .25 per cent., sulphur .16 per cent., phosphorus .25 per cent., manganese .1¼ per cent.

These rails were put down on one of the hardest worked roads in England, the Great Western, 7-ft. gauge, and they stood all the tests. We could bend them double and they were excellent in every way. In those days rails were made open hearth, running .28 to .50 per cent. carbon, phosphorus .04 to .06 per cent. manganese ran from .05 to .09 per cent., sulphur .02 to .06 per cent.

An analysis of a rail that was returned as excellent by the engineer, was .0287 per cent. phosphorus, 1.234 per cent. manganese, .24 per cent carbon.

Then came an excitement about copper in rails, and we had to make copper analysis right along, finding from .01 to .07 per cent., but we could not find that it affected rails in any way, either in the rolling or testing, so the scare finally died out.

We used to roll rails up to 90 lbs. per yd. at Landore. Some were 4½ ins. high, with web ¾ in. thick. They were flanged rails, 30 ft. long.

We made axles with from .28 to .35 per cent. carbon, .05 per cent. phosphorus and sulphur, and .75 per cent. manganese, cast into 15-in. ingots, hammered under a 7-ton hammer down to an 8-in. bloom and finished under another hammer. The ultimate tests would run from 80,000 to 90,000 lbs., with an elongation of 18 to 20 per cent. in 8 ins., the test being to place them 3 ft. 7½ ins. centers, and drop a ball weighing 1,000 lbs. from heights of 5 to 35 ft., the axle being turned after every blow. Another test was to bend the axle double until the journals touched. We made a softer axle, 70,000 to 75,000 lbs. tensile strength, with elongation 20 to 25 per cent. in 8 ins.

We rolled tires from 21 ins. up to 8 ft., from an ingot 15 ins. or larger. These ingots were cut into what we called cheeses, hammered, then put on a projection on the side of the anvil and thus shaped, and then the tire was finished under hydraulic pressure and rolled. Our tires ran about .22 to .28 per cent. carbon, sulphur and phosphorus .05 per cent., manganese .08 per cent.

On the same mill we made weldless rings for boilers. The plates of our boilers were butted together, and these weldless rings were riveted over the joint, either inside or out. We also made weldless angle rings, for connecting the smoke box to the shell, thus making a boiler with very few joints.

We also made lips for dredges. These lips wear out quickly, but by turning around from time to time, a great deal of work could be obtained from each lip.

We made rings, solid rolled, for compressed air vessels, about 12 ins. deep, and ⅝ in. to 1¾ in. thick, with a rim on them. We also made tin plates of soft steel, from .10 to .15 per cent. carbon, .05 per cent. sulphur, and phosphorus .04 per cent. The manganese was as low as .2 per cent., but it made magnificent plate. We rolled the ingots down into bars 6 ins. × ½ in. cut into lengths, then rolled across the bar into the plate. The test of these plates is that they must stand clamping in a vice and bending backward and forward some 14 or 15 times before cracking. Our first plate stood this 18 times and had a most beautiful surface.

Among other things we made moulds for gun barrels and weldless tubes. Also wire rods of a special kind, called conductivity wire. In England the post office owns the telegraph and requires a wire which shall fulfill certain electric tests. It contains about .15 per cent. carbon, phosphorus and sulphur .04 per cent., manganese not over .4 per cent. About 1875 or 1876 we started to make the first shapes for the British Government vessels *Iris* and *Mercury*. We made our deck beams from large ingots, 15 to 18 ins. square. We had some trouble at first, but were soon able to roll successfully up to 12 ins. high. The steel was .19 to .21 per cent. carbon, sulphur .06 per cent., phosphorus .07 per cent., mangenese .75 per cent.

We forged piston rods up to 18 in. diameter, weighing 7 tons; locomotive axles and double throw cranks, cross heads and shafts. Our specification was .15 per cent. carbon, phosphorus and sulphur, .05 per cent., manganese .8 per cent. I believe that of all the bad heats I ever made, 99 out of 100 were due to running the metal too hot. It should be run at such a temperature that it thickens as it runs from the ladle. It ought to drop in the mould as it cools. If not you will have blow holes in the castings. We found copper melters the best men to run a furnace, We never had any trouble in welding our forgings, and frequently were obliged to patch out shafts and piston rods. We also cast anchors for ships, with .58 per cent. carbon, low sulphur and phosphorus. We had no success with rolls, except very small ones for making tin plate. They were 1.02 per cent. carbon and made an excellent surface.

I have here an analysis of a shaft made for the English Government in 1879 of cast steel. The analysis is .16 per cent. carbon, .03 per cent. silicon, .05 per cent. phosphorus and sulphur, .882 per cent. manganese. The tensile strength was 54,650 lbs. and 20 per cent. elongation in 8 ins. A test piece was twisted around itself five times before it broke. The shaft is now running in one of the large iron clads.

The most interesting part of our work was the manufacture of steel plates. Some of the earliest plates we made were frame plates for locomotives, with about .17 per cent. carbon, and in this connection I want to point out that there is a considerable difference in the chemical analysis between American and English plates. And there is considerable difference between a plate rolled on a three-high mill, and a plate reheated and rolled on a two-high mill. The ship builders have adopted what was called a standard plate, with .17 per cent. carbon, .03 to .07 per per cent. silicon, .06 per cent. phosphorus, .07 per cent. sulphur, and from .07 to .08 per cent. manganese. In an average of 41 tests it gave 63,700 lbs. tensile strength, with elongation 26 to 28 per cent. in 8 ins.

Another kind called Liverpool Lloyd steel has .19 to .21 per cent. carbon, with manganese .08 to .09 per cent. Its tensile strength runs from 71,000 to 72,000 lbs. with 28 per cent. elongation in 8 ins. The manganese goes as high 18 per cent. The elongation seems to rise in proportion to the increase in manganese

Our method of making these plates was to cast large ingots from 15 ins. to 18 ins. square, hammering them down under a heavy hammer, and cutting into slabs, which were reheated in a Siemens furnace, and then finished on a two-high reverse mill.

We made bridge plates, some having carbon .40 per cent. The test was 96,000 lbs. tensile strength, with elongation of 18 per cent. in 8 ins. They were for a bridge in India, and after they got there it was found a mistake had been made in the punching, and they had to repunch them, breaking about all the tools in the country. Our ordinary bridge steel was .35 per cent. carbon, 82,000 lbs. ultimate, .18 per cent. elongation in 8 ins. We rolled our ends into skelp, which was made up into boiler tubes. We welded from .05 per cent. carbon to .80 per cent. In steel for welding I always kept phosphorus and sulphur as low as possible. We made boiler plates with elongation .25 per cent. in 10 ins. with tensile strength above 60,000 lbs. One batch was carbon .15 to .16 per cent. low phosphorus and sulphur, 62,000 lbs. tensile strength with 32 per cent. elongation. Another 61,000, 33 per cent. elongation; 62,000 showing 31 per cent. and 63,000, showing 33¾ per cent.; all in 10 ins. The reduction before fracture was 52 per cent.

Some people think the tests of the U. S. Navy Department are very hard. I have made plates for twelve different Governments before this one. The average of these plates was 64,000 lbs. with 26 per cent. elongation in 8 ins.; also 63,000 lbs. with 26⅛ per cent. in 8 ins. The tests we use here are about 62,000 lbs. with 25 per cent. in 8 ins. I find we are really making the same steel for the United States as for all the Navies in the whole world, as our tests so far have averaged about 62,720 lbs. ultimate, with 27 per cent. elongation and 53 per cent. reduction.

The analysis of the English plates alluded to is .16 per cent. carbon, .08 per cent. manganese, whereas the average of United States plates is .19 to .21 per cent. carbon, .05 per cent. manganese. Having been struck by the difference in chemical analysis coupled with the similarity in physical properties, I sent to the largest steel works in England for their average result of Government work for the last year. It is, .16 to .17 per cent. carbon, .05 to .06 per cent. manganese, phosphorus and sulphur under .05 per cent., silicon about .01 per cent., copper .05 per cent. Ultimate strength 65,000 lbs., elongation 25 per cent.

The plates I made in 1879 and '80 were, 16 per cent. carbon, .08 per cent. manganese, average 65,000 lbs. tensile with 26 per cent. elongation in 8 ins. Before quenching, the plate would pull 62,000 lbs., with an elongation of 25 per cent.; after quenching, it pulled 84,000 lbs. with an elongation of 20⅛ per cent. Then it was annealed, again quenched, and then tested, and it went back exactly where it was before.

Steel of 61,200 lbs. tensile strength with 21 per cent. elongation, after hammering went up to 75,200 lbs. with the elongation of 14 per cent.

A plate that broke at 59,000 lbs. before quenching, went up to 79,000 lbs after quenching. A ¾-in. plate pulled 65,700 lbs. with 21 per cent. elongation, and the same plate rolled down to ⅝-in. went up to 70,200 lbs. with 19 per cent. elongation.

In England, steel below 60,000 lbs. tensile strength is rare. As all their steel is hammered and cogged it is tougher and harder, with less elongation than the American product, but the American steel is worked by a more rational process, and we can make a greater variety, and have better success in fire-box work.

Completion of Nicaragua Canal Surveys.

Cables from San Carlos, Nicaragua, state that the whole line of the Nicaragua canal will be located by June 10, including complete and thorough surveys of the two possible locations on the east end, known as the "Lower Route", surveyed by Commander

LULL in 1872-3, and the shorter "Upper Route" surveyed by Mr. MENOCAL in 1885.

It is stated that all problems have been successfully solved, so that on the return of the engineers sent home to plot the work the company will be in possession of the data necessary to prepare for subconstruction.

Chief Engineer PEARY will remain in Nicaragua with two parties, one on the west side and one on the San Juan, to make local surveys in vicinity of the canal line, to confirm former records of the rise of the lake, and of the flow of important streams at various stages during the rainy season. One of the boring parties will also remain to complete the work on the west side, which will probably extend into the month of July.

A few engineers from the East side will return home by way of Greytown, and some from the west, by Panama. The Jamaica laborers will be sent to Kingston in a body, where their accumulated wages will be paid by the company's agents. The parties remaining will employ native labor. The entire force is in good health, as it has been throughout the surveys.

Mr. MENOCAL will go to the west side to visit the President, from whom he has received very cordial letters.

At the end of April Mr. MENOCAL made a careful examination of the harbor east of Greytown. A steam launch and a surf-tug were placed at his disposal for this purpose, by Mr. PELLAS, the owner of the lake and river transportation, who also assisted in the work and pointed out the recent changes in the vicinity of Harbor Head, due to the combined forces of the sea and recent freshets. This examination is reported to have confirmed Mr. MENOCAL'S previous impressions as to the effects of the waves and the littoral currents, and strengthened his belief in the correctness of the plans proposed for the restoration of the harber.

PUBLICATIONS RECEIVED.

Tables of the Properties of Saturated Steam and Other Vapors. By CECIL H. PEABODY, B. S., John Wiley & Sons, New York. pp. 60, 8vo, cloth, $1.00.

The title of this volume clearly indicates the character of its contents. It is complete, convenient and cheap, and is well adapted to the needs of engineers and technical students, for whom it was prepared.

In an Introduction are given the original data of REGNAULT'S experiments on the properties of saturated steam, and of ROWLAND'S experiments on the mechanical equivalent of heat, and the specific heat of water, together with the formulæ derived from them. All of the tabular values were calculated directly by aid of these formulæ, without approximation, and are carried to as many places of significant figures as the data warrant. These calculations were checked by the method of differences, and are believed to be correct.

Two tables are given of the properties of saturated steam in English units, one for each degree Fahrenheit, and one for each pound pressure. A table in French units is given for each degree of Centigrade. Tables are given, in French units, of the properties of saturated vapors of alchohol, ether, chloroform, carbon bisulphide, carbon tetrachloride, and acetone; all based on REGNAULT'S experiments. Approximate tables are given of the properties of saturated sulphur dioxide and ammonia.

Selections from Buildings designed by EDWARD A. KENT, Architect, Buffalo, N. Y. 24 plates:—A neat example of the reproduction of architectural designs now so frequent with architects, including a wide variety of very tasteful buildings.

Land Laws Decisions. With a Review of some recent decisions of the Supreme Court of Michigan, being a report of the Michigan Engineering Society, at its Ninth Annual Meeting. By F. HODGEMAN.

This little pamphlet is chiefly devoted to the discussion of certain recent decisions which it is claimed, "tend to unsettle the surveys and subdivisions of fractional sections in Michigan running through a period of 68 years."

The decisions thought to be erroneous are all based upon the principle that "no grantee by patent granting a legal subdivision of land can derive title to land upon another legal subdivision".

The cause of this controversy seems to be in the interpretation of the word "fractional". As used in the land department of the U. S. and by surveyors it means an irregularly bounded tract, or shows that the tract was not one of the regular subdivisions. But a fractional lot was never limited by U. S. authority to the boundaries of the tract from which it took its name. The opinions of the Michigan judges, however, were that a "fractional ¼" could not extend beyond the regular quarter lines, ignoring the intentions of the grantor, and the mention of quantity in the description. In one case an L shaped section occupying a narrow strip along the west and south sides of a regular section was transferred under the designation "the south fraction". A suit followed and it was decided that this designation did not include any land north of the east and west quarter line, although the area called for required this part to be included.

World English: the Universal Language. By ALEXANDER BELL; New York, N. D. C. Hodges. Small pamphlet 29 pp.

Notwithstanding the unfavorable reception universally accorded to spelling reformers, Mr. BELL advocates a method of phonetic spelling and a new way of writing English which will discard three of the letters now used and require the introduction of nine new characters which are modifications of old ones. These changes, the author asserts, will "clear away the dense mist of letters which now obscures the English language" and make it easy for beginners to acquire. Literary English is not to be interfered with, at present, but the world English is to be the initiatory stage for the learner and the international language of the world. The author appeals to the press to facilitate the introduction of his system, and says that he anticipates no opposition from any quarter.

In this we think he is mistaken. The object which he has at heart is a most important and desirable one, which our industrial and manufacturing interest especially ought to look favorably on, since a more rational system of spelling the English language would greatly tend to enlarge the future trade relations with the world of the English speaking nations, in which we shall doubtless have in time the lion's share, but like most enthusiasts our author goes too far. All the serious anomalies of English spelling might be removed by comparatively simple changes, but in order to have his system "perfect" our author must needs introduce new single characters for such perfectly simple combinations as ch, sh, th, wh, ng, etc., making his new spelling hopelessly impracticable.

SOCIETY PROCEEDINGS.

American Society of Civil Engineers.—The regular meeting was held June 6; Vice-President J. J. R. CROES in the chair. The Secretary announced the death of WM. L. BAKER. Mr. W. E. WORTHEN stated, with regard to a newspaper report to the effect that Mr. JAS. B. FRANCIS had met with a serious accident, that the accident in question happened to the son of Mr. FRANCIS, who was knocked off a pier by the boom of an excavator, breaking both his legs. Announcements as to the Convention were substantially the same as printed last week (p. 455).

No paper was presented, but the Secretary read some interesting information, furnished by Mr. JAMES MOORE, relative to the old Philadelphia, Germantown & Norristown Railroad (now a part of the Philadelphia & Reading) and its locomotive "Old Ironsides", the first locomotive built by Wm. Baldwin, of Philadelphia, founder of the Baldwin Locomotive Works. The engine had four wheels, the driving axle being near the front of the fire-box, and it weighed about 7 tons. It made its first run on Nov. 26, 1832, and ran regularly in all kinds of weather. A photograph of a drawing of the "DeWitt Clinton", the old 3½ ton engine of the Mohawk & Hudson Railroad, was exhibited. The Secretary mentioned a case where a bridge built on a skew had one panel at the end of one of the trusses longer than the other; when erected it was found that the man in charge had got the truss wrong end foremost, and the floor beams would not go in. The superintendent of the bridge company floated a large boat under the truss and filled it with water, false work was then built up on the boat and the truss fastened to it; the water was then pumped out, the boat floated and towed to a point wide enough to be turned round, then towed back to the site, filled with water and the truss placed in its proper position. Mr. C. E. EMERY referred to the recent instance of floating a bridge at Chicago, from its piers and towing it down to a new site, passing through two drawbridges. Mr. T. COOPER stated that the Pennsylvania Railroad was beating both records by carrying 90 foot girders as freight, supporting them on three cars.

The following candidates were declared elected:

MEMBERS.

WILLIAM HENRY BALDWIN, City Surveyor, Yonkers, N. Y.

WILLIAM MURRAY BLACK, Captain of Engineers, U. S. A., St. Augustine, Fla.

DEXTER BRACKETT, City Engineer's Dept., Boston, Mass.

FRANCIS SMITH BURROWES, Lancaster, Pa.

WILLIS CHIPMAN, City Engineer, Brockville, Canada.

LEFEVRE DEYO, Asst. Eng., N. Y., N. H. & H. R. R., Harrison, N. Y.

HENRY GOLDMARK, Bridge Engineer, Kansas City, Fort Scott & Gulf R. R., Kansas City, Mo.

LEWIS MUHLENBERG HAUPT, Consulting Engineer, Philadelphia, Pa.

JOSEPH WARREN HOOVER, Wrought Iron Bridge Co., Kansas City, Mo.

LEWIS BLAKE JACKSON, Chief Eng., Joliet, Aurora & Northern Ry. and Elgin, Joliet & Eastern Ry., Chicago, Ill.

CASSIUS WILLIAM KELLY, New Haven, Conn.

ALEXANDER MCCOMB MILLER, St. Louis, Mo.

RICHARD MONTFORT, Chief Eng., L. & N. R. R., Louisville, Ky.

JOHN FRANK STEVENS, Prin. Asst. Eng., Duluth, South Shore & Atlantic Ry., Marquette, Mich.

ASSOCIATE.

LOUIS DE COPPET BERG, New York City.

JUNIORS.

ANDRE FIERRE TACHARD, New York City.

JOB TUTHILL, Asst. Eng., Detroit, Lansing & Northern R. R., Ionia, Mich.

Engineers' Club of St. Louis.—The club met at Washington University at 8.15 P. M., May 30, President HOLMAN in the chair; 28 members and 3 visitors present. The secretary read the following:

"The committee appointed by the president to consider the advisability of this club co-operating with the Kansas City and other engineering clubs in reference to proposed State legislation for the safety of public bridges, as indicated in the herewith accompanying report of the Kansas City club, do unanimously agree that we regard it desirable for our club to co-operate with them for the object specified. We deem it the duty of the club to aid such action from both a public and professional standpoint, and think that persistent effort will succeed in finally obtaining such legislative action on this important matter, in which the engineering clubs should take the initiative.

[Signed] H. A. WHEELER, C. H. SHARMAN, MAX G. SCHRINKE, } Committee."

The chair appointed ROBERT MOORE, C. H. SHARMAN and A. W. HUBBARD, a committee of three to co-operate with Kansas City and other engineering clubs in furthering legislation on the subject of improvements in highway bridges. Mr. R. E. MCMATH read a paper on "The Water-Way between Lake Michigan and the Mississippi river, by way of the Illinois river". The author having been in charge of the government work on the Illinois river for some years, was able to treat the question in the light of experience. He referred to canals in general and gave special attention to the various schemes connected with the Illinois river, as well as the Hennepin canal and the complications due to the Chicago drainage. He considered his subjects under the following heads: Physical, Sanitary, Economical and Political. The author thought the scheme was of great importance and promised decided benefits.

On motion it was ordered that 1,000 copies of this paper be printed for circulation. The special order of the day was then taken up, being action on the recommendations contained in the report adopted at the last meeting, on the subject of National Public Works. The report provided for a committee on finance and one on correspondence. On balloting, the following committees were chosen: Finance, J. B. JOHNSON, R. E. MCMATH, ROBERT MOORE, W. B. POTTER and E. D. MEIER. Correspondence, J. B. JOHNSON, R. E. MCMATH, E. D. MEIER, F. E. NIPHER and C. M. WOODWARD. The meeting then adjourned.

W. H. BRYAN, Secretary.

Montana Society of Civil Engineers.—The regular monthly meeting was held at Helena, Mont., May 19. Mr. E. H. BECKLER, Chief Engineer of the Montana Central Ry., read a paper on "Railway Location", which was discussed, and which will be continued at the next meeting. The Secretary read correspondence with L. E. COOLEY, President of the Executive Board of the Council of Engineering Societies on National Public Works. Mr. GEO. T. WICKES, of Helena, was elected a member. Mr. J. S. KEBLE, was appointed to represent the Society in the Board of Managers of the Association of Engineering Societies.

CONSTRUCTION NEWS.

RAILROADS.

East of Chicago.

Existing Roads.

Philadelphia & Reading.—The great event of the week in financial circles has been the subscription for the new bond issue of this company. The total opened to subscription was $24,850,000 bearing 4 per cent, inter-

est. The books were opened for subscription simultaneously in London, New York, Boston and Philadelphia, at 10 A. M. Wednesday, June 6, and were closed by noon, the amount subscribed having by that time largely exceeded the whole issue.

South Pennsylvania.—ROBERT H. SAYRE, of the Lehigh Valley, is quoted as follows, in reference to the prospects of this company:

"While the Lehigh has no interest in the South Pennsylvania, it is favorable to the building of it. I hope that the work will now be resumed and pushed forward vigorously. The work upon it already amounts to $5 000,000, and the men who are actively interested in it will most certainly push it forward to completion. The lower courts have already decided against the Pennsylvania Railroad, and I do not believe that the management of that road will be able to cause any interference with the building of the South Pennsylvania. My impression is that the Pittsburg interests have the power to push it through. I think that with such men as CARNEGIE, HOSTETTER and BAGELEY taking hold of it there can be no question of its successful termination. The Lehigh Valley is ready to have direct connection with it. At the Allentown junction the South Pennsylvania can have two splendid New York connections—one with the Lehigh and another with the New Jersey."

The suits of the Pennsylvania against the South Pennsylvania are to be heard soon in New York.

Pemberton & Hightstown.—The Union Transportation & Construction Co. has been organized by citizens who reside along this line, recently abandoned by the Pennsylvania and the road is to be leased from the Pennsylvania and will be opened again for business on June 25.

Maine Shore Line.—Some grading is in progress on this Maine road between Machias and East Machias. Only enough work is to be done, however to preserve the life of the charter.

Lehigh Valley.—The branch from Fairview to Pittston, Pa., is nearly finished and it is hoped to be able to open it for business by Sept. 1. The line is about 20 miles in length and will serve as a cut-off for the main line.

Napanee, Tamworth & Quebec.—Surveys are reported in progress for the extension from Tamworth to Tweed, Ont. E. W. RATHBUN of Deseronto, Ont., is General Manager.

Hancock & Calumet.—A branch is to be built to Woodstock, Mich., a distance of about 3 miles.

Toledo, Saginaw & Mackinaw.—The contract for building five depots between East Saginaw and Durand has been let to M. S. STEWART of Flint.

Rome, Watertown & Ogdensburg.—It is reported that work is to begin soon on a short connecting link between this line and the Buffalo, Rochester & Pittsburg at Rochester, N. Y. The surveys for the work are now in progress.

Grand Trunk.—A charter has been secured for a short line from Glencoe to Wamstead but its construction has not yet been decided upon.

Pennsylvania, Poughkeepsie & Boston.—The Springfield *Republican* says:

"Ground was broken at Poughkeepsie, N. Y., and the work of construction was begun on the section of the Pennsylvania, Poughkeepsie & Boston railroad from Poughkeepsie to Silvernails bridge, on the Hartford & Connecticut Western road, forming the connection between the Poughkeepsie bridge and New England. The road is to be finished during the present season."

This announcement has been made so many times within the past year that we are getting to expect it as often as once a month. The ground doesn't seem to stay broken about the Poughkeepsie bridge connections, and also there doesn't seem half the anxiety to build railroads to yard it from all points of the compass that there was a year ago.

New Projects and Surveys.

Elkhart & Western.—Organized at Elkhart, Ind., by E. C. BICKEL, C. H. WINCHESTER, J. R. BEARDSLEY and J. L. BRODERICK, of Elkhart, to build a railroad from that city to Mishawaka. This is a move toward the completion of the old Michigan Air Line, owned by the Chicago & Grand Trunk, of which the gap, 61 miles in length, from Mishawaka to Jackson has never been built.

Clifton Avenue Incline Plane.—This company has been organized at Pittsburg, Pa., by WM. MCLEERY, WM. A. STONE, CHAS. A. COOPER and others, to build a passenger and freight inclined plane railway in Allegheny.

Clearmont & Kinzua.—Incorporated in Pennsylvania, to build a railroad from Lafayette, on the Pittsburg & Western, to Reynolds, about 5 miles. G. W. CAMPBELL, of Kane, Pa., is president.

SOUTHERN

Existing Roads.

Berkeley Springs & Potomac.—This railroad runs from Hancock Station, B. & O. R. R., up the Warm Spring river valley 6 miles, to Bath (or Berkely Springs) the county seat of Morgan county, W. Va. The work is generally very light with maximum gradients of 1.1 per cent. and maximum curvature of 19° 30'. The entire line is now under construction by C. D. Langhorne of Hancock, Md., contractor. Tracklaying has begun at the Hancock end and the work will be finished this summer. B. F. DEFORD of Baltimore, Md., is President and CHAS. GOLDSBOROUGH, Asst. Eng'r. B. & O. R R., is in charge of the work.

Roanoke & Craig.—The contract for the construction of the Craig Company's Railroad from Roanoke, Va., to Newcastle, has been let to F. J. Chapman & Co. The line is to be completed within 18 months from May 30, 1888. The line to be built is 15 miles in length, and the contract price is $300,000 in first mortgage bonds besides such local aid as has been secured. J. W. MARSHALL of Lynchburg is President of the Craig Company.

Wilmington & Sea Coast.—It is expected that the first trains will be run over this road on June 12. The line extends from Wilmington N. C. to Wrightsville, a distance of 10 miles.

Chattanooga, Rome & Columbus.—The last rails are being laid on this line which runs from Chattanooga, Tenn., to Carrollton, Ga., a distance of 140 miles.

Anniston & Atlantic.—The reported sale of this company to the Central R. R. of Georgia is officially denied.

Tennessee Midland.—The completed section of this line extending from Memphis to Jackson, Tenn., a distance of 85.5 miles was opened for business May 31, with an excursion of the principal officers over the line. Grading is making rapid progress on the 50 miles from Jackson to the Tennessee river.

Tennessee & Coosa.—The Montgomery (Ala.) *Advertiser* states that 85 bids were received for building the extension from Gadsden to Huntsville, advertised in ENGINEERING NEWS of April 28: Messrs. Danforth & Armstrong, the successful bidders, agree to complete ten miles of track within 90 days and the whole work prior to Jan. 1, 1889. The contractors' headquarters will be at Huntsville.

Natchez, Jackson & Columbus.—It is proposed that the city of Natchez, Miss., vote aid to this company to the amount of $25,000 toward the expense of changing the gauge between Natchez and Jackson.

Georgia Pacific.—Grading has begun at several points between Winona and Johnsonville, Miss.

Pensacola & Memphis.—Grading has begun on this road at Pensacola Fla.

Carolina, Knoxville & Western.—About ten miles of the grading from Greenville, S. C., north is now ready for the iron, and tracklaying began at that point on June 6.

Warrior Coal Fields.—The city of Meridian, Miss., will vote on June 12, on the proposition to aid this company to the amount of $110,000.

Ohio River.—Surveying parties are to be sent out at once on the proposed extension of this West Virginia road. Lines are to be run from Sisterville and New Martinsville to Clarksburg, and from Weston to Ravenswood.

Richmond & Chesapeake.—About forty hands broke ground for the tunnel for this road, at Richmond, Va., on June 4. R. E. O'BRIEN, of New York, is Chief Engineer. C. E. BELVIN, of Richmond, is President, and J. M. LUM is Engineer in Charge.

Louisville Southern.—Lexington, Ky., has voted in favor of granting a subsidy to the proposed extension from Lawrenceburg to Lexington, 25 miles.

Kansas City, Memphis & Birmingham.—The proposed extension from Aberdeen to Columbus, Miss., is under survey. The line will be about 28 miles in length.

Baltimore & Ohio.—It is reported that the company's managers are debating the question of an extension of the Harper's Ferry & Valley branch, from Lexington to Roanoke, Va. Should the Roanoke & Southern line be successfully completed, such a move would not be improbable.

Roanoke & Southern.—Nearly 4 miles of grading are reported completed, near Martinsville, Va. Locating surveys are still in progress.

New Projects and Surveys.

Kentucky Midland.—The company is endeavoring to obtain an additional subscription of $100,000 from the city of Frankfort, Ky. The Capital Construction Co. has been organized with J. M. THOMAS, President; R. W. MCCRARY, Secretary; and GRANT GREEN, Treasurer. Mason & Ford are said to have made an advantageous offer for the whole contract. About $750,000 has already been secured in local aid and prospects for early construction seem very favorable.

Anniston, Williamsport & Highland Cave.—Incorporated in Alabama with a capital stock of $120,000 by W. H. WILLIAMS, W. F. JOHNSTON, MILTON A. SMITH and C. E. ANDERSON.

Selma & Cahaba Valley.—The office of Pierson, Crocker & Co., the principal movers in this enterprise, at Selma, Ala., has been closed; and it is inferred that there is no present prospect that the enterprise will be carried through.

Atlantic, Atlanta & Great Western.—The preliminary surveys of this Georgia road are now under way. W. H. PRYOR is Chief Engineer, with headquarters at Atlanta.

Hawesville & Pellville Mineral.—It is reported that work is to begin in very soon on the grading of this Kentucky road. D. L. ADAIR, of Hawesville, Ky., is President.

Atlantic & Pacific.—Certainly Southern railway promoters are not always modest and unassuming in their choice of names if the following from the *Manufacturer's Record* is to be relied on:

"R. N. Hood, H. H. Taylor, W. M. Hood, J. M. Hood and John Hood have chartered the Atlantic & Pacific Railway Co. to build a railroad from near Knoxville to the Tennessee river, about ¾ mile long."

Charlotte & Weldon.—JOHN S. WEBB of Charlotte, N. C. is making a preliminary survey for a railroad to Weldon.

Madison & Eatonton.—A reconnoissance has been made for the proposed railway line from Madison to Eatonton, Ga. VIRGIL POWERS and JOHN CRUTCHFIELD of Macon are interested.

THE NORTHWEST.

Existing Roads.

Duluth & Iron Range.—Tracklaying has just been completed on the extension from Tower to Ely, Minn., 21 miles, and the line will be opened for business about July 1. R. ANGST is Chief Engineer, and Shepard, Winston & Co., were the contractors.

Wisconsin Central.—Grading was begun at Wausau, Wis., on the Wausau, Merrill & Abbotsford extension on May 31. It was necessary to begin construction before June 1 in order to avoid the loss of a valuable land grant.

Chicago, St. Paul & Kansas City.—About a year ago parties working in this company's interest secured an option on an extensive tract of land and water front near Superior, Wis.; and surveys were made for an extension from St Paul to Lake Superior. It is now given out that the option on the Superior real estate has been allowed to expire. Doubtless the holders of the option had no fear but what they would be able to renew it when they chose at still more favorable terms. It does not seem probable that the extension to Lake Superior will be built very soon.

Mason City & Fort Dodge.—A number of short branches are to be built this season to open up new coal fields near Lehigh, Ia.

Mineral Range.—This line extending from Hancock to Calumet, in the North Michigan peninsula, has been placed in the hands of a receiver, CHAS. A. WRIGHT.

Aberdeen, Bismarck & Northwestern.—Track will be laid this season on the graded line from Bismarck, Dak., southeast to the junction with the Minneapolis & Pacific extension. The end of the line toward Aberdeen is not to be ironed at present.

Minneapolis & St. Louis.—This company on June 1, defaulted on the interest due on its bonds to the amount of $91,000. For the first three months of the year the net earnings of the company were $109.712 less than the fixed charges. President TAUESDELL ascribes the shortage to the peculiarly onerous effect which the Interstate Commerce law has had on this line: but he also asserts his belief that the surfeit of railway lines in the Northwest combined with the demagogic attitude of State legislators, will lead to grave trouble in the future.

Chicago, Milwakee & St. Paul.—It is reported that this company has acquired that portion of the Iowa Central Railroad between Oskaloosa and Keithsburg. It is rumored that an extension is likely to be undertaken to Burlington, Ia. It is very much more likely, however, that for some time to come the wholesale extension policy of the company will be laid to one side and the new mileage to be built will be exceedingly small. President MILLER has taken hold of the companys' affairs with an energy most commendable, declares that as long as he holds the office of President, no bonds shall ever be issued to pay dividends, and has issued a general order obliging the strictest economy to be exercised in every department.

St. Louis, Alton & Terre Haute.—The annual meeting was held at St. Louis on June 5, and the old officers were re- lected. In discussing the extension of the Marion Division, which will be about 54 miles long, and will form the most direct line from Paducah to Chicago and St. Louis, the General Manager's report says: "The road is practically being built under our supervision, and we have the control and right to operate it for 978 years on a basis of 30 per cent. of its gross earnings, guaranteeing the principal and interest of $1,000 000 first mortgage 5 per cent. bonds, or a minimum rent of $50,000 per annum for the use of the railroad and equipment. It is located across the Ozark range of mountains, and consequently is an expensive road to build, but will be fully completed and well equipped with rolling stock before this company takes possession of it. It will furnish an additional market and outlet for the extensive coal territory traversed by our present lines."

Milwaukee, Lake Shore & Western.—On the extension from Rhinelander, Wis., toward Hurley, about 300 men are at work and it is expected to reach Tomahawk lake by July 1.

New Projects and Surveys.

Nebraska & Western.—This company has been incorporated in Nebraska with a capital stock of $9,000,000 to build a railroad from a point opposite Sioux City, Ia., through Dakota, Dixon, Wayne, Antelope, Wheeler, Loup, Logan, Grant, Sioux, Sheridan and other counties. The incorporators are JAMES D. NEGUS, DONALD MCLEAN, MILLARD R. JONES, ALBERT IMGARD and DAVID B. PAIGE. The project is supposed to be in the Illinois Central interest.

La Crosse, Mineral Point & Highland.—This company has been incorporated in Wisconsin to build a railroad from La Crosse to the State line in Green county, about 130 miles. ALBERT W. COBB, W. H. BENNETT, PHIL. ALLEN, Jr., of Mineral Point, Wis., RICHARD KENNEDY of Highland, and B. F. WASHBURN of Excelsior are interested.

Canada, La Crosse & Southwestern.—This project of which F. A. ROZIENE is President and whose headquarters are at La Crosse, Wis., has not gone ahead so fast with its large enterprise as its sanguine promoters expected. That the company is still alive, however, we conclude from the following paragraph in the London *Financial News*:

CANADA, LA CROSSE AND SOUTH-WESTERN RAILWAY CONSTRUCTION COMPANY LIMITED.

"Registered by T. T. Hull, 22, Chancery lane, W. C., without articles of association, and therefore the clauses of the first schedule of the Companies Act, 1862 will apply. Capital £200,000, divided into 20,000 shares of £100 each. Object, to construct a railway from Sault Ste. Marie, in the State of Michigan, in the United States of America, running in a south-westerly direction through the States of Michigan, Wisconsin, Minnesota, Iowa and Missouri to St. Joseph, in the State of Missouri, a distance of about 910 miles, or any part thereof, or to promote the construction of the whole or any portion thereof and for this purpose to build and erect any stations, buildings or other erections, and equip and work the whole or any portion of such railway".

Winnipeg & Southeastern.—The provincial directors of this Manitoba company at their recent meeting at Winnipeg elected W. F. ALLOWAY, President, N. W. WATSON, Vice President, and KENNETH MACKENZIE, Secretary & Treasurer.

Sioux City & Northern.—It is reported that the contract is to be let at once for a line from Sioux City, Ia., to Sioux Falls, Dak., the project being backed by the St. Paul, Minneapolis & Manitoba.

THE SOUTHWEST.

Existing Roads.

Kansas City & Southern.—Tracklaying was completed June 1 between Kansas City and Belton, Mo. The whole line from Kansas City to East Lynne, with the branch to Hart's Grove, will be in operation by July 1. The principal owner of the road is JOHN I. BLAIR, of New Jersey. B. 3. WHITNEY, of Kansas City, was Chief Engineer, and Schnellbacher & Gilman, of Kansas City, were the contractors.

Chicago, St. Paul & Kansas City.—Real estate for terminals has recently been secured in Kansas City, adjoining the terminals of the Kansas City, Wyandotte & Northwestern. Work is expected to begin about July 1 on the extension from St. Joseph, Mo., to Leavenworth, Kan. The tracks of the Wyandotte & Northwestern are to be used between Leavenworth and Kansas City.

Gulf, Colorado & Santa Fé.—Work has begun on the 36 mile extension from Ballinger to San Angelo, Tex., under Contractors Ricker, Lee & Co. of Galveston.

Austin & Northwestern.—On the extension from Burnet to Marble Falls, Tex., about 16 miles, the grading is well advanced. F. H. Holloway, of Burnet, is the contractor. The extension will probably be continued to Llano, 36 miles from Marble Falls, at an early date.

Kansas City, Fort Scott & Gulf.—A survey is in progress for a line from Carbon Center, Mo., the terminus of the Rich Hill branch, to Eldorado Springs, about 15 miles. S. W. CLAPP is Chief Engineer.

Union Pacific.—About 600 hands are at work on the extension from Colby to Waldo, in western Kansas.

New Projects and Surveys.

Interstate Railway Construction Co.—Incorporated in Arkansas with a capital stock of $500,000. J. B. SIMPSON is President, and C. H. HUFFMAN, SOL. F. CLARK, E. O. CLARK and P. O. DOOLEY are directors.

Waco & Brazos Valley.—The citizens of Waco, Tex., have subscribed $10,000 toward the grading of this road. The line is to be about 65 miles in length, running from Waco to Cameron. If no heavier local aid than this can be secured, the prospects for the construction of the line do not seem very promising.

Dallas, Archer & Pacific.—President GEO. F. ALFORD, of Dallas, states that the contract for building this line from Dallas to Archer, 140 miles, has been let to "a Chicago syndicate", who are to finish the work within a year.

Abilene & Wichita Falls.—A survey was made some time ago by direction of the Abilene, Kan., board of trade, to Wichita Falls, Tex. The maps and profiles of this survey are to be submitted to the Rock Island managers, and it is hoped to induce them to build the road.

Dallas & New Orleans.—This Texas company has executed a mortgage to the Mercantile Trust Company, of New York City, as trustee upon its proposed line in Tarrant Co., Tex.

Paris, Choctaw, & Little Rock.—It is reported that surveys are soon to begin on this road, which is to run from Little Rock, Ark., to Paris, Tex. The bill granting right of way across Indian Territory has been favorably reported in Congress. S. J. WRIGHT, of Hot Springs, is President.

ROCKY MOUNTAIN & PACIFIC.

Existing Roads.

Pueblo Union Depot.—The Managers of the Pueblo Union Depot Co., met on May 29 and decided upon the location, increased the capital stock from $150,000 to $300,000, approved plans, accepted the trackage scheme submitted, and admitted into the association the Rock Island company. The next meeting is to be held on June 26. C. L. STONAKER, Secretary of the Pueblo Board of Trade is interested.

Mexican National.—The track laying on the northern division is in progress below Catorce and the whole line to San Luis Potosi will be completed by Aug. 1.

Mexican Inter-Oceanic.—There seems to be no doubt that this English enterprise is to be carried out. The London *Financial News* devotes a column to it and to the prospect of its actually building a competing line to the Mexican Railway between Vera Cruz and the City of Mexico. It says:

"If the Inter-Oceanic scheme be carried out on its present lines, it must be a danger to itself as well as to the Mexican Railway; but it might be so modified as to become a useful ally instead of a deadly rival. One half of it—namely, the western section—from Morelia to Acapulco is quite outside the sphere of the Mexican line. Had it been put forward as a distinct and independent project we could have conscientiously supported it. Even shareholders in the Mexican Railway Co. might have been encouraged to put their money into it as a desirable connection for their own road. Nor is the eastern section altogether beyond recommendation. In so far as it traverses the tableland country it has created traffic for itself, and will do no further harm to the Mexican. By-and bye it may be possible to say as much for the extension to Puebla, now being built.

But it is from Puebla onward to Vera Cruz that competion threatens to be suicidal. Half the distance is mountainous country—genuine unmitigated mountains nine or ten thousand feet high, and no mere cockney imitations. The very best pass which can be found will necessarily be costly both to build and to operate. A railway running in such country will hang in mid-air, far removed from any possible source of traffic. To build one line through such a region was bad enough without giving it a competitor. For unprofitable grandeur there is nothing to compare with it in Europe, not even the railway over the Brenner Pass."

"If the Inter-Oceanic people are determined to cross this Rubicon, regardless of consequences, it would be much less risk for them to widen their existing line from Vera Cruz to Irolo, and get running powers of some kind over the Mexican. It may be objected, and very plausibly, that such an arrangement would be awkward for both companies. After all that has come and gone between them, the Mexican and Inter-Oceanic would be strange bed-fellows; but better mutual inconvenience than mutual disaster. Each company must recognise its neighbor as a fact which has come to stay. The practical question is, how they are to live together, doing each other the least possible harm.

"Supported by the Mexican Company the Inter-Oceanic can readily get all the money they need for their western extension to Acapulco, which in itself promises to be a much better paying venture than scaling mountains 8,000 or 9,000 ft. high. Without prejudice to the rest of their scheme they would be wise to carry out that part first. It lies beyond the range of controversy, and will always tend to strengthen their position in view of future negotiations with other roads. A time might come when it would be of importance for the Mexican Railway to have working powers or some other form of close relation with the Acapulco road."

Nevada & California.—About 250 hands are grading the extension north toward Susanville, Cal.

Union Pacific.—Surveys are in progress for the London Junction & Leadville cut-off. The distance is about 15 miles and the range will propably be pierced by a tunnel.

Denver & Rio Grande.—The forty mile branch from Sapinero to Lake City, Col., was surveyed and partly graded in 1884; but work was suspended when the company's affairs were placed in a receiver's hands and has never been resumed. There is said to be some prospect that the unfinished line may soon be taken up and completed.

Eureka Flat & Wallula.—Grading is making good progress on this Washington Territory line which is under construction by G. W. HUNT of Portland, Ore., and about 12 miles are ready for the track.

New Projects and Surveys.

Monterey & Tampico.—Surveys are in progress on this Mexican road for which MORRIS R. LOCKE of Jerseyville, Ill., has the contract. WM. H. WENTWORTH, formerly employed on the Mexican National, is in charge of the locating surveys.

Wyoming Midland.—This company, whose incorporation was noted last week, is endeavoring to secure the passage of a bill through Congress permitting the company to build its line through the Wind river Indian reservation in Wyoming.

Contracting.

Revetment.—The following proposals for the construction of a stone revetment on the earthen slopes at the locks of the Louisville & Portland canal have been received by Major AMOS STICKNEY, U. S. Engineer Office, Louisville, Ky.; P. H. Sweeney, Jeffersonville, 1400 cu. yds. of face stone, $2.22 per cu. yd.; gravel or rock backing, 74½ cts. or $1.20 per cu. yd.; building 4000 sq. yds. of revetment, 39½ cts. per yd.; total, $5,200.50 or $5,528. J. D. Hamilton, Louisville, $2.60 for stone, $1.10 or $1.40 for backing, 45 cts. for revetment; total, $6,210 or $6,420. Joseph Nevin, Louisville, $1.90, $1.50, 74 cts. $6,670. Phillip Donohue, Louisville, $4.85, 90 cts., 38 cts., $8,940. Roderick Mackenzie, Louisville, $4.48, $1.15, 56 cts., $9,317. Wm. F. Shanks, Louisville, $6.15, $1.10, 50 cts., $11,380.——The stone will be a durable limestone; face stones to average 12 ins. in width and length and not less than 4 ins. thick. The backing to be of limestone broken to 3 ins. or gravel of ¾ in. pebbles. The revetment will consist of one thickness of face stone laid dry, and backed with broken stone or gravel placed upon the revetment slopes (1:2) which will be prepared by the government. The total thickness, including face and backing will be 18 ins.

Street Work.—The Bd. of Pub. Impts., St. Louis, Mo., has awarded contracts as follows: For grading, curbing, guttering, crosswalks and Telford paving: St. Louis Granite Co., $22,782.80, $3,460.50; J. E. Perkinson, $2,062.10, $5,586.15; Fruin-Bambrick Construction Co., $8,859.75.——For grading, curbing, guttering, crosswalks and macadamizing: Daniel Cavanagh, $17,216.20; St. Louis Quarry Co., $8,850; J. L. Perkinson, $1,757; J. C. Steffen, $4,031.15.——For grading and filling: Fruin-Bambrick Construction Co., $760.——For alley improvement: Bambrick-Bates Construction Co., $1,574; J. E. Perkinson, $1,927.80; St. Louis Quarry Co., $684.20, $921.40, $1,590, $3,447; Louis Grund, $850.80; Martin Lorenz, $972; G. Eyermann, Jr., $723.——The prices of the bids ranged as follows: grading, 21 to 35 cts.; curbing, 50 to 85 cts.; guttering, $14.35 to $18; lower course Telford, $4 to $7; macadam, $4 to $5; gravel, $7.50 to $10; rolling, $7 to $10; crosswalks, $1.30 to $2.50; loam sand, $3 to $10; river sand, $7 to $10. Grading and filling, 9½ cts. to 27 cts. Grading alleys; 18 cts. to 32 cts.; paving alleys, $13.50 to $17.

Engine and Boiler House.—The following proposals for the construction of an engine and boiler house at Sandy Hook, N. J., have been received by Major D. P. HEAP, U. S., Engineer Office, Tompkinsville, N. Y.: D. L. Conover, Atlantic Highlands, N. J., $1,956; F. Rinschler, Stapleton, N. Y., $2,275; J. E. Demise, Oceanic, N. J., $2 300; John Brady, New York, $2,400; Murphy & Hayden, New York, $3,465.

Granite, Cement, Etc.—The following proposals have been received by the Commission for the construction of the Congressional Library Building, Washington, D. C.: Cut granite: Mt. Waldo Granite Works, Frankfort, Me., $33,919; Bodwell Granite Co., Rockland, Me., $34,230; Maine Granite & Improvement Co., Washington, D. C., $39,886.20; Westham Granite Co., Richmond, Va., $43,439; Milford Pink Granite Co., Boston, Mass., $48,000; Hallowell Granite Works, Hallowell, Me., $48,706; Sargent & Sullivan, Concord, N. H., $51,357; Rockport Granite Co., Rockport, Mass., $53,950; Southern Granite Co., Cincinnati, O., $63,313.60.——Natural hydraulic cement: Cumberland Hydraulic Cement & Mfg. Co., for Cumberland cement, $1.04⅞ per bbl. of 300 lbs. net; J. G. & J. M. Waters, for Round Top hydraulic cement, $1.09; Lawrence Cement Co., for Hoffman Rosendale cement, $1.27; Howard Fleming, for "A" Rosendale cement, $1.29.——Sand: Jno. S. Ellis, Washington, 97 cts. per cu. yd.; Ann Miller, Washington, 98 cts. and $1.07; E. M. Colford, Washington, $1.03; Jno. B. Lord, Washington, $1.10; Barber Asphalt Paving Co., Washington, $1.50; Jno. M. Hickey, Washington, $1.55.——Broken stone: J. S. Ellis, Washington, $2.24; D. L. Shoemaker, Washington, $2.24; Barber Asphalt Paving Co., Washington, $2.50.

Electric Lighting.—The Gas Commission, New York City, has awarded contracts as follows: East River Electric Light Co., 453 lamps at 35 cts. each per night; U. S. Electric Light Co., 352 lamps at 35 cts.; Ball Electric Light Co., 48 lamps at 27½ cts.; Harlem Electric Light Co., 49 lamps at an average of 35 cts. and 2 on 3rd Ave., bridge at 60 cts.; Mt. Morris Electric Co., 85 lamps at 23 cts. and 35 cts.; North New York Lighting Co., 50 lamps at 35 cts.; Brush Co., 441 lamps at 35 cts. Some trouble has been caused by the fact that the lowest bids in some cases were from new companies which have not yet any lamps or plant, but the United States and Harlem companies agreed to light the territory disputed in their respective districts until the matter could be settled.

The National Water Purifying Co., of New York City, has issued a handsome 4 page circular descriptive of the National filter, and its operation. There are two engravings of the filter.

Pipe.—M. Coogan has the contract for 15,325 ft. of wrought-iron pipe for the Fire Dept., Milwaukee, Wis, at 14⅝ cts. per. ft.

The Kansas City Gravel & Tile Co. has been incorporated at Kansas City, Mo., to manufacture and deal in brick, cement, and other building materials. Capital stock, $150,000. Directors: W. T. LITTLE and W. R. LITTLE, of Kansas City; J. L. PENDRY, of Leavenworth, Kan.; B. P. MCNAIRE, Colwich, Kan.; L. O. SMITH, Haven, Kan.

Tunnel and Shaft.—The Water Commissioners, Buffalo, N. Y., have received the following proposals for enlarging the inlet shaft and water supply tunnel: John Hickler, $21,850; D. W. McConnell and Peter Hickler, $22,244; John Druar, $29,700. The shaft will be enlarged 2 ft., making it 6 ft. diameter and the tunnel will be enlarged to 6 ft. for a length of 16 ft. Work will be commenced this month and completed in the Fall. When the capacity of the enlarged tunnel becomes too small, which will not be for some years, a new tunnel will have to be built.

Dam.—Geo. B. Jordan has the contract for a dam for the Linen Co. at Willimantic, Conn.

Church.—The contract for the construction of the new stone church for St. Stephen's parish has been awarded to C. Gillingham & Co., of Olean, N. Y. The church will cost about $30,000.

Bridge Repairs.—The following proposals for the repair of the Little Kanawha River bridge between Parkersburg, W. Va., and Newport, have been received by the County Commissioners: T. A. Black, $7,200; E. B. Henderson & Son, of Marietta, $7,490; Smith Bridge Co., Toledo, O., $7,850; R. Merrydith & Son, Marrietta, $8,100; F. R. Stewart, Mannington, $8,200; N. W. Tucker, $9,000; Wrought-Iron Bridge Co., Canton, O., $9,000; L. Campbell, $9,800. The contract was let to T. A. Black, who sublet it, by permission, to E. B. Henderson & Son.

The Carolina Construction Co. has been incorporated at Charleston, S. C., by A. SIMONDS, M. CUNNINGHAM, F. W. DAWSON, G. W. WILLIAMS and W. A. BRANDLY. Capital stock, $30,000. The company will build water-works, etc.

Court Houses.—The contract for the court house at Jefferson, Tex., has been awarded to J. H. COSTER, of Baltimore, Md., for about $31,000.——The contract for the court house at Lincoln, Neb., has been awarded to W. H. B Stout at $162,476.42.

Street Signs.—The American Enamel Co., of New York, has the contract for 500 street signs at Portland, Me.

Stone Bridge.—The following proposals have been received for the construction of the stone bridge across the Charles river at Waltham, Mass.: H. H. Pike & Co., Cambridge, $38,000; McCarthy & Lahey, Boston, $46,600; Trumbill & Cheney, Boston, $49,460; D. H. Cram, Boston, $54,490. The appropriation is only $35,000.

Water-Works. — ***Washington, Mo.*** — The Water Committee has received proposals from F. W. Raeder, of St. Louis: F. W. Fritchmann, of Chicago; J. A. Jones, of Kansas City: and the Interstate Gas & Water Works Co., of St. Louis. The first two did not comply with the committee's specifications and were rejected and the committee recommended the acceptance of the bid of the Interstate Gas & Water-Works Co., which will give the city 4¾ miles of mains and 50 hydrants at an annual rental of $3,000.

Concrete Walks.—The contract for concrete walks for the city of Springfield, Mass., has been awarded to C. M. Mead, of Chicopee, at 50 cts. per yd.

Street Cleaning.—Gen. BEAUREGARD, Commissioner of Public Works, New Orleans, La., has been taking decided steps to have the streets of that city properly cleaned. The Council not having made a sufficient appropriation for the work he called upon the citizens to raise $40,000 by subscription. The appeal met with a hearty response, several thousand dollars were pledged and a number of firms gave the use of their teams. The gutters are to be thoroughly cleaned out.

Stand-Pipe.—The following proposals for the construction of a stand-pipe have been received by the Jefferson City Water-Works Co., of Jefferson City, Mo.: E. E. Palmer & Son, Kansas City, $9,556; Shickle, Harrison & Howard, St. Louis, $11,650; John O'Brien, St. Louis, $11,995; J. F. Wangler, St. Louis, $15,800. The contract was awarded to E. E. Palmer & Son. J. B. JOHNSON, of St. Louis, is the engineer.

Chattanooga Bridge.—The Decatur Bridge Co., of Decatur, Ala., has forfeited the contract with the Chattanooga Bridge Co., an organization formed to erect a bridge across the Tennessee at Chattanooga. Negotiations are now pending with several other bridge companies. Over $500,000 cash is pledged to the enterprise, and the most conservative judges estimate that the bridge will pay annually 18 per cent. on a $2,000,000 investment.—*The Tradesman.*

Machinery.—The contract for the machinery for Sage & Potter's new mill at Churchville, N. Y., has been awarded to Geo. T. Smith, of Jackson, Mich., and for the engine and boiler to the Woodbury Engine Co., of Rochester, N. Y.

Jail.—W. L. Landrum, of Mayfield, Ky., has a contract for a rotary jail at Watseka, Ill., to cost $40,000.

Sewers.—***Newark, N. J.***—The following contracts have been awarded by ERNEST ADAM, City Surveyor: Mt. Pleasant Ave. sewer; Hughes & Flynn, 10, 12 and 15-in. sewer pipe, 75 cts., 99 cts. and $1.20 per ft.; manholes, $33; flushing tank, $70; basins, $100.——Clifton & 8th Aves. sewer; Satchwell & Bellingham, 12-in. pipe, $1.09; manholes, $32; basins, $110.——Union St. sewer; Thomas O'Connor, 12 and 15-in. pipe, $1.35, $1.60; manholes, $35; basins, $105.

Atlanta, Ga.—The following proposals have been received by M. MAHONEY, Commissioner of Public Works: C. Dalvigney, $33,238.20; D. W. Liddell, $34,562; M. E. Maher, $35,839.70; J. J. Everson, $38,072.50. The contract was awarded to C. Dalvigney.

Plattsmouth, Neb.—The following proposals have been received: Haubens & Shelton, Omaha, $29,918; D. J. Keleher, Omaha, $30,521; Nevill & Murphy, Plattsmouth, $31,870.50. The contract was awarded to Haubens & Shelton.

Electric Railways.—***North Adams, Mass.***—An electric railway will be built by representatives of the Thomson-Houston Co., of Boston. C. Q. RICHMOND, of Boston, is interested.

Revere, Mass.—The Revere Electric Street Ry. Co. will commence work shortly. W. G. BENEDICT, President.

Huntington, W. Va. — The Huntington Electric Lighting Co. wants supplies for equipping an electric street railway.

Street Railways.—***North Danville, Va.***—The North Danville Herdic & Street Ry. Co. has been organized.

Rome, Ga.—A new street railway company has been organized to build a line from Rome to Printup City.

Gadsden, Ala.—The Gadsden Street Ry. Co. has been organized, and will build a "dummy" line.

Pensacola, Fla.—The Pensacola Gulf, Land & Development Co. will build a street railway this season.

Palatka, Fla.—The Palatka Heights Street Ry. Co. has been organized by WM. P. CRAIG and M. GRIFFIN. Capital stock, $10,000.

Poughkeepsie Bridge.—The contract for painting the bridge has been awarded to C. H. Bilson, of Albany, N. Y., at $40,500.

Sewerage System.—The following proposals have been received at Aberdeen, Dak., for a complete system of sewerage, including excavation, manholes, flush tanks, pump well, pump house, artesian well, filth chamber, and hoist pumping machinery: brick and pipe sewer; iron discharge pipe and all other material necessary to the completion of the system according to the plans and specifications: E. P. Conser, Edgely, Dak., special plans, $15,000; H. P. Bolles, Aberdeen, certain alterations in plans, $17,987, or according to prepared plans, $41,011.25; Phillips & Hobson, Huron, $43,289; S. F. Sykes & Co., Minneapolis, Minn., $38,074; E. W. McGarrick & Co., Des Moines, Ia., $52,625.75.

Artesian Well Plant.—S. Freeman & Sons Mfg. Co., of Racine, Wis., are contemplating putting down a 12-in. artesian well, and wish to correspond with parties having apparatus for doing the work.

Artesian Well.—Daniel Dull, of New York, has the contract for an artesian well for Belding Bros., at Northampton, Mass. Work will be commenced at once.

Reservoir.—The contract for the reservoir at Wheeling, W. Va., has been awarded by the Water-Works Trustees to W. M. Chisholm, of East Liverpool, O., at $30,900.

The Asphalt Block Mfg. Co., of Chicago, Ill., has been incorporated by JESSE D. FROST, HENRY C. BERRY and GEO. W. ADAMS, to manufacture asphalt paving blocks and tile. Capital stock, $100,000.

Gravel.—The following contracts have been awarded by W. MCDONALD, Superintendent of Streets, Boston, Mass.: Screened hill gravel: John F. Kelly, Roxbury, for South Boston, District A, 88 cts. and $1.75 for single and double loads, 20 and 38 ft. Owen Nawn, Roxbury, for city proper, District B, $1 and $1.99; for Roxbury, District C, 87 cts., and $1.74; for Dorchester, District D, $1 and $2.——Beach gravel, John T. Scully, Cambridge, 83 cts. per ton.

Pumping Engine.—The Deane Steam Pump Co., of Holyoke, Mass., has the contract for a new pumping engine for the water-works at Anniston, Ala., to replace an engine that broke down recently.

Proposals Open.

Water-Works.—Complete system. JOHN T. ALLEN, Pulaski, Tenn.

Street Lighting.—The City Clerk, Santa Rosa, Cal.

Pumping Engine.—Water power pumps, 3,000,000 to 5,000,000 galls. daily capacity. L. P. RHODES, City Engineer, Lynchburg, Va.

Track Material.—Rails, splice bars, spikes, etc., and locomotive; new or second-hand, delivered at Houston, Tex. D. A. TOMPKINS & Co., Charlotte, N. C.

Street Lighting.—Gas or electricity, or both as at present. Term of 3 years, for streets already lighted. JACOB K. ROMINE, Chairman, Lighting Committee, Orange, N. J. June 11.

Electric Lighting.—Lighting the city with arc lights of 2,000-candle power. THE LAMP COMMITTEE, Schenectady, N. Y. June 11.

Sewers.—THE COMMISSIONER OF PUBLIC WORKS, 31 Chambers St., New York City. June 11.

Sewers, Reservoir, Etc.—Sewers, smoke stack and brick reservoir at Insane Asylum. L. L. NESMITH, Agnews Station Santa Clara Co., Cal. June 13.

Sidewalks.—Flagging sidewalks. THE COMMISSIONER OF CITY WORKS, Brooklyn, N. Y. June 13.

Building.—New Jersey agricultural experiment station. GEO. K. PARCELL, New Brunswick, architect. Dr. GEO. H. COOK, Rutgers College, New Brunswick, N. J. June 14.

Sewer.—Pipe sewer, 585 ft. of 12-in.; 10 ft. deep; 4 manholes; 36 house connections. Separate bids for carrying each house connection to curb line. ERNEST E. COX, 742 Broad St., Newark, N. J. June 15.

City Hall.—At Garrettsville, O. WM. P. GINTHER, architect. E. L. DAVIS, Village Clerk, Garrettsville, O. June 15.

Water-Works.—Complete system, pumping plant, etc. A. T. CATHERWOOD, Chairman of Water-Works Committee, Hoopeston, Ill. June 15.

Street Work.—Excavating, granite and cobble paving, curbing, purchase of old material, etc. THOS. J. LANAHAN, Clerk, Board of Contract, Albany, N. Y. June 18.

Pipe, Hydrants, Etc.—Cast-iron pipe, branches and castings; tapping cocks and boxes; hydrants, stop-cocks and boxes; iron railing at High Bridge reservoir. THE COMMISSIONER OF PUBLIC WORKS, 31 Chambers St. New York City. June 19.

Pier Work.—Crib bulkhead at E 119th St., Harlem River; crib bulkhead from W. 75th St. to W 77th St., North River. THE DEPARTMENT OF DOCKS, Pier A, North River, New York City. June 20.

Sewer Bonds.—For $55,000. THE BOARD OF SEWER COMMISSIONERS, Greenbush, N. Y. June 23.

Building.—State normal school at Oneonta. FULLER & WHEELER, of Albany, architects. W. H. MORRIS, Oneonta, N. Y. June 25.

Electric Lighting.—The city will take 30 arc lights and the plant is to be owned by the contractor. THE MAYOR, Jackson, Miss. July 1.

Bridges.—Proposals, with detailed plans, specifications and strain sheets, for the construction of four bridges over the Salinas river in Monterey Co., Cal.; including approaches and protection work to confine the river within its present banks. Separate bids. H. SAMUELS, Chairman, Board of County Supervisors, County Clerk's Office, Salinas City, Cal. July 10.

WATER.

St. Paul, Minn.—There is some talk of obtaining a water supply in the future from Lake Mille Lacs, about 90 miles north of the city, and 868 ft. above the level of the city. The Rum river flows out of it and the supply could be drawn from that river at Princeton.

Uniontown, Pa.—At a meeting of the Fayette Fuel Gas Co. it was decided to proceed at once to pipe natural gas from the Rider well. The distance is 6 miles and there will be 4¾ miles of pipe within the borough. Nearly the entire $24,000 stock has been subscribed for. The contract for pipe has been awarded to the Chester Pipe & Tube Co., of Philadelphia, and work will be commenced at once.

Minneapolis, Minn.—Engineers RINKER, FANNING and DE LA BARRE, who have been appointed a commission to examine the condition of the apron and other improvements at the falls, have not made any examination or prepared a report. Engineer RINKER states that it will be impossible to make any satisfactory examination while the river continues at its present stage, but the committee will begin operations as soon as the water recedes sufficiently. Nothing has been done toward distributing the cost of needed improvements between the interested corporations.

Drainage in Wisconsin—A system of drainage is proposed for the purpose of reclaiming land in Dane Co., Wis., which has now over 12,000 acres which are entirely worthless and can only be reclaimed by the proposed system.

Electric Light at Pittsburg.—It is reported that negotiations are in progress for the consolidation of the Westinghouse Electric Co. with the Edison Electric Co.

Addison, N. Y.—The President and Trustees of the village have awarded to the Addison Water-Works Co. the right to construct water-works; the same to be completed within one year. President, E. M. WELLES; Treasurer, H. C. HITCHCOCK; Secretary, GEO. C. HOWARD.

Seneca, S. C.—The new water-works will be built by the Richmond & Danville R. R. Co., and will cost about $2,000. The present supply is from wells. The new supply will be taken from a spring and pumped to tank; hydrant pressure being used for fire purposes. The population is 800.

Merced, Cal.—The Merced Gas & Water Co. is contracting for an electric light plant for the city. Preparations are also being made for an electric road. The plant will be operated by water power.

Gas Works.—*Knoxville, Tenn.*—The Knoxville Gas Co. will expend about $15,000 in improvements and extensions.

Shelbyville, Ky.—The gas works have been purchased by H. D. FITCH, of Louisville, Ky., who will extend the mains and improve the works. The price for coal gas will be reduced from $1 to $2 per 1000 cu. ft.

Anniston Ala.—The pipe laying and plant for the new gas works are progressing satisfactorily. It is expected that the city will be supplied by gas by July 1.

The New York Hydraulic Supply Co. has been incorporated by GEORGE RICHMOND, W. J. DOBSON and F. W. DIEHL, to supply hydraulic power. Capital stock $25,000.

Crookston, Minn.—The city is supplied with water and the electric light by the Crookston Water Power & Electric Light Co. The water supply is by direct pressure. The pumps are driven by two water-wheels of 75 H. P. each, and there is an 80 H. P. engine with 100 H. P. boiler for use in case of emergency. The dam gives a head of 12 ft. The supply is 2,500,000 galls. per day. There are 6¼ miles of mains, and 40 double-nozzle hydrants. Ordinary pressure, 60 lbs.; fire pressure, 150 lbs. The Van Depoele electric light system is used; there are 10 street arc lights and 30 private lights, all of 2,000 candle power. Incandescent lights are to be put in.

Autofagasta, Bolivia.—The Compania Huanchaca de Bolivia has decided upon the construction of the necessary works for supplying the port of Autofagasta, on the Pacific coast, with pure water, and is advertising the work in the English technical papers. The adopted project comprises 342,550 yds. of piping capable of providing 2,500 cu. metres of water per day. The source from which the water is to be secured is situated 10,510 ft. above sea level, and there is railway communication from the port of Autofagasta to the source of supply. The European agent of the company is R. PEDO, 5 b s, Rue de Berri, Paris, France, from whom further particulars may be obtained, and to whom estimates and proposals must be addressed.

Galveston, Tex.—The City Engineer, H. T. WILSON, in a recent report to the Council, stated that a system of sewerage was badly needed. The following systems were referred to: 1. The separate system or "Waring" system as in use at Memphis, Tenn.; 2. The pneumatic or "Shone" system; 3. The "West" system, controlled by the National Sewerage & Sewage Utilization Co., of New York. The Shone company, of Chicago, represented by U. H. BROUGHTON, submitted two propositions to the city, the first for the city to grant a franchise, the second for the company to build and own the works and charge a rental for each house connection.

Water-Power at Waterloo, N. Y.—The State Superintendent of Public Works has been authorized to make the Seneca river and Bear race improvements at Waterloo, N. Y. The water power of Waterloo was originally divided equally between the north and south sides of the river. The land on the south side with the privilege of half the water of the river was bought by Samuel Bear from the State at an early day. When the State built the canal the channel was deepened on the north side to enable small canal boats to float. Again in 1857 the canal was enlarged and was deepened to 7 ft., thus enabling the north side to not only have boating facilities, but to draw nearly all the water in the stream during low water, the south river channel never having been deepened. The flour mills are all located on the south side and receive their grain largely by canal from Seneca and Cayuga lakes and from the west, and, therefore, have more use for canal facilities than any other interest on the canal, but at present they find it necessary to unload boats and transfer all the wheat and flour by teams to and from the mills. The Legislature of 1887 appropriated $15,000 to dredge out the canal and river down to the dam, but the superintendent found that he could not do the work very well under the provisions of the bill, and the Legislature of 1888 passed the present law authorizing him to do the work at his discretion.

Helena, Mont.—The new water-works, described on page 460, were tested May 24, with satisfactory results. At the highest part of the city where pipe is laid the pressure was 50 lbs. and a 1¼ in. stream was thrown to a height of 82 ft. and to a horizontal distance of 111 ft.; at the court house the pressure was 62 lbs. and a 1¼ in. stream was thrown to a height of 93 ft. and a distance of 126 ft.; at a low point the pressure was 158 lbs., and a stream was thrown to a height of 180 ft. and a distance of 210 ft. The 2 boilers are 80 H. P. each. The well is 40 ft. in diameter, and 26 ft. deep, with 12 driven well points 50 ft. deep and 4 to 6 ins. diameter at the bottom. The reservoir is located 460 ft. above the works and is 18 ft. deep below the overflow. The city engineer, A. E. CUMMING, reported to the Council that there are now 13.52 miles of 4, 6, 8, 10 and 12-in. pipe, and 2.7 miles of 12-in. force main: the total system being 15.82 miles; with 96 gates. The Blake pumping engines are of the following dimensions; high and low pressure steam cylinders, 16 and 28 ins. diameter; stroke, 18 ins.; diameter of water cylinders, 11 ins. Capacity of each pump, 1,500,000 galls. per day. The Water Committee reported that all the conditions of the ordinance have been carried out, except that 11 hydrants are yet to be set, and these will be put in as required, and they recommended the acceptance of the works by the city. The works were formally accepted by the City Council May 25, care being taken to specify that they were constructed under ordinance No. 95, in order not to mislead as to the original water-works ordinance No. 93, which was declared invalid by the courts. The franchise was originally granted to GEORGE F. WOOLSTON, of New York, who built the works, but he transferred the franchise to Turner, Clark & Rawson, of Boston. The engineers in charge of the work were J. FRANK WILLIAMS and GEO. E. EVANS.

Water-Works.—*Maine.*—Boothbay. Judge DANFORTH has decided that the contract between the town and the water company is regular and valid.——Portland. Work is in progress on the North St. reservoir, which will have a capacity of 20,000,000 galls.——Saccarappa. The Portland Water Co. has decided to accept the proposition made to it by the town and favorably acted upon in March, to give the town an adequate supply of water for all purposes for $2,000 per annum for 15 years.

Massachusetts.—Easthampton.—The Valley Machine Co. has put a duplex steam pump into the works of the Easthampton Rubber Thread Co. to furnish the town with water for domestic purposes and fire protection.

Connecticut.—Windsor Locks. The Windsor Locks Water Co. has received two bids, one from Goodhue & Birnie and one from a New York firm. The latter proposition is for a route which will shorten the distance 1¼ mile and give a greater pressure. This will be surveyed at once. The cost was estimated at about $25,000, and the work would be completed in 7 weeks after commencement.

New York.—Franklin. Water-works are projected and it is desired to use electric power for pumping.——Seneca Falls. The new stand-pipe is completed and in use; the city now has a supply of excellent water from Cayuga Lake, 3 miles distant.——Oneonta.——Work on the reservoir is being pushed to completion.——Clyde. The Clyde Water Co. has been organized: CHARLES R. BASSETT, President. A site for the tank has been selected, surveys are being made for the pipe lines, and the material has been ordered. The village trustees have signed the contract with the company.

Pennsylvania.—Tarentum. A reservoir 80 ft. diameter and 15 ft. deep is to be built and pipe laid. Address M. BRACKENRIDGE, Natrona Pa.——Scottdale. A water company has been organized by leading citizens. A reservoir will be located at Mt. Vernon at an elevation of 160 ft.

Ohio.—Youngstown. Address the Clerk of the Water Board with regard to proposed extensions of the water-works.

Virginia.—Lynchburg. The City Council has appropriated $20,000 for an additional pumping engine of 3,000,000 galls. daily capacity for the water-works.——Crewe. The Glamorgan Co. of Lynchburg, has contracted to build water-works for the Norfolk & Western R. R. Co. at this new town on the line. The cost will be about $10,000.

Tennessee.—Pulaski. As soon as the estimate of cost is prepared, the water-works question will be submitted to public vote. The works are wanted as early as possible and correspondence with contractors is solicited.——Memphis. The artesian water supply has been turned on and the whole city will be supplied by the end of the year. The former supply has been from Wolf river, which is muddy.

Georgia.—Columbus. Work is in progress on the brick foundation for the stand-pipe. The pipe will be completed by September and will have a capacity of 200,000 galls.——La Grange. Water-works are projected. Address the mayor.

South Carolina.—Orangeburg. The city has made a favorable contract with Mr. GEO. H. CORNELSON, the proprietor of the Orange cotton mills, by which the city gets for a nominal sum the use of all the water it needs from the artesian well which Mr. CORNELSON bored some years ago for his factory. A stand-pipe 72 ft. high and 8 ft. diameter, with a capacity of 25,000 galls., has been erected in a central location, and water is supplied through 1,800 ft. of 6-in. pipe, covering the entire business portion of the city. The stand-pipe furnishes a pressure sufficient to throw a good stream of water from any of the hydrants to the top of the highest buildings. At present the water is used mainly for fire protection and for watering the streets in summer, but it is proposed before long to extend the system and introduce the water into private residences.——Greenville. As the city would not put in water-works a manufacturing firm having control of a spring, put in a steam pump, erected large tanks on the roofs of 2 large buildings, and laid pipe and set hydrants on Main St. The firm is paid by subscriptions from business men.

Alabama.—Bessemer. The new water-works are to be extended shortly.

Florida.—Tampa. The material for the water-works has been delivered and pipe laying will soon be commenced.

Michigan.—St. Ignace. Water-works are to be constructed and the issue of bonds for $10 000 is now being advertised. Bids will be received till June 11.

Illinois.—Jerseyville. The works will probably not be completed by July 4 as originally intended. The pumping station is completed but the machinery is not yet delivered.——Jacksonville. A proposition has been made by W. G. DECKER to sink a 5-in. artesian well to a depth of 2,500 ft. if necessary, for $6,400. The Council refused to make a contract.

Kansas.—Herington. The Herington Light & Water Co. has a contract to supply water for 20 years. Work will be commenced shortly.

Nebraska.—Sutton. Water-works are projected. Address Alderman MATTISON.

Colorado.—Cascade Canon. This town on the Colorado Midland R. R., laid out by the Cascade Land & Town Co., has had a system of water-works put in.

Wyoming.—Cheyenne. Improvements are to be made at the water-works by DONALD MILLER, City Engineer.

California.—San Jose. A new water supply company has been organized.——Los Angeles. The City Water Co., has placed a loan of $300,000 in San Francisco, the money to be used for extending the system.——Sacramento. The pumping facilities are to be increased, the city having outgrown the capacity of the present pumping plant. Bids are to be invited for a pump of 10,000,000 galls. daily capacity. Address Superintendent WOLF.

Texas.—Orange. A pump and other material for water-works will be purchased by Lutcher & Moore.——Ennis. Surveys for the water-works have been made by W. M. JOHNSON. Address the mayor for particulars.

Electric Light and Gas.—*Machias, Me.* The Machias Electric Light Co. has been incorporated to supply light and power. President, G. LONGFELLOW; Treasurer, H. H. TAYLOR. Capital stock, $9,000.

Athol, Mass.—By the new electric light franchise the 13 arc lights are to be paid for at $100 per annum and 20 incandescent lights at $15 each.

Ware, Mass.—The incandescent lights have been established on Main St.

Portland, Conn.—An electric light system is to be put in. A committee has the matter in charge.

Fort Plain, N. Y.—The electric light and power plant will be in operation by July 1.

Greenport, N. Y.—The Edison Light Co. is negotiating to put in a plant of 150 incandescent lights for stores and houses. The streets are lighted by the Thomson-Houston system, which has been in operation satisfactorily since September, 1887.

Shelter Island, N. Y.—The Edison Light Co., expects to put in a plant of 1000 incandescent lights; about 300 being for two hotels and the balance for cottages and street lighting.

Marysville, Ky.—The Edison Electric Co. is negociating to put in a plant.

Gainesville, Ga.—The Thomson-Houston Co., of Boston, Mass., will put in an electric light plant.

Raleigh, N. C.—The Raleigh Gas Light Co., will put in an electric light plant.

Algiers, La.—The Louisiana Electric Light Co., of New Orleans, has laid a cable across the Mississippi and furnishes light in Algiers, Gretna and Freetown. This is said to be the first electric light cable laid under so large a body of water as the Mississippi.

Kansas City, Kan.—B. Freidburg has been granted an electric light franchise and will put in a $35,000 plant. The city will take 50 lights at $7,200 per annum, to supersede gasoline lamps costing $11,500.

Hastings, Minn.—The Thomson Houston electric light system has been put in operation.

Madison, Wis.—The Thomson-Houston electric light system was turned on lately but was not entirely successful and new engines were telegraphed for. The streets are lighted and all the lights will be in operation shortly.

Dallas, Tex.—The Dallas Electric Light Co. will spend $40,000 in improving and extending its plant.

Santa Barbara, Cal.—The Santa Barbara Gas Co. has bought out the electric light company and will improve the electric light plant.

Chico, Cal.—A company has been organized to operate the electric light plant and put in plants at other cities. Capital stock, $100,000. JESSE ANTHONY, Dr. A. MCFADYEN, and others, are directors.

Santa Cruz, Cal.—The new electric light works are in operation.

Montreal, Canada.—The Royal Electric Light Co. will make a proposition to extend its plant to light the whole city.

Carlyle, Ill., May 26.—Thursday and Friday of this week the Circuit Court of this county was engaged in hearing the suit of the Water, Light & Power Co. against the city of Carlyle for refusal to accept and pay the first instalment on the water-works plant recently erected by this company, the principal owners of which reside in St. Louis, Mr. GRANT TILDEN being a large share holder. The contract was entered into early last year and the plant was in operation in September, but the contract called for about 3½ miles of mains, stand-pipe, engine, pumps, buildings, hydrants, etc., and water was to be forced to certain heights in different parts of the city. At one of the tests water was forced to a height of about 115 ft. in two places, but in a subsequent test it appears was not forced to the agreed height, and for this reason the City Council refused to accept the plant. Judge AMES WATTS, who was on the bench, rendered his decision this morning substantially as follows: "That the ordinance relating to the contract constituted a valid and binding obligation upon the city, and that the city was bound to accept and pay for water when plaintiff had thrown water from its hydrants the height required by said ordinance; that plaintiff failed to prove that it had thrown water the required height, and therefore could not recover for non-acceptance, and that the evidence did not show that the city had made any use of the water, and hence judgment was rendered for defendant." —The Court further found that, in all respects except throwing the water the height required, the plaintiff had fully complied with the ordinance. The contractors will undoubtedly take the case to a higher court, unless a compromise is effected in the next few days. Under the stipulations of the ordinance the city was to pay $2,100 annual rental for fire purposes. The cost of erecting the works was about $35,000.—St. Louis (Mo.) *Globe Democrat*.

Special Reports of Water-Works Construction.

THE ENGINEERING NEWS MANUAL OF AMERICAN WATER-WORKS is now being compiled, and will be *indispensable* to every manufacturer, engineer and contractor in any way interested in Water-Works construction and maintenance, and will be of great value to Water-Works superintendents and projectors of new works.

Superintendents of water-works and water companies will wish to see correct and complete data concerning their Works in our MANUAL, and to ensure this they should send in reports *at once* upon the blanks which we have already sent to every Water-Works office in the United States and Canada. Many have delayed their report, and if the blanks we intended for them have been lost in the mail, or mislaid, we will send more upon request.

We *must* have a report from every public water-supply system in North America, so those who reply to our inquiries at once will save a second inquiry. We also wish to know of *every* new Water-Works plant in process of construction, and of *every* new project in this line. We will send to any one desiring them, blanks upon which reports can be made.

Further details of the MANUAL will be advertised later. We abstract from our special reports for the MANUAL the following items of current interest:

SEAL HARBOR, Me., May 31, 1888.

EDITOR ENGINEERING NEWS:—This is a sea-side watering place with a population of 400. Water-works for domestic supply and fire protection are projected by the Seal Harbor Water Co. The proposed source of supply is Jordan's pond, 250 ft. above tide level, and two miles away. We think the works will cost about $30,000, and are depending upon our hotel proprietors, summer residents and permanent householders to subscribe for our stock and bonds. The mains will be of 8, 6 and 4-in. pipe. We hope to build the works the coming fall.

SAM'L. F. BARR, *President Seal Harbor Water Co.*

NORTHFIELD, Vt., May 30, 1888.

EDITOR ENGINEERING NEWS:—A special meeting was recently called at this place and a committee appointed to consider the water-works question. As a result of some measurements taken under my direction, it has been found that an ample supply of water can be obtained from a mountain brook, the flow on May 16 being at the rate of 6,000,000 galls. a day. An abandoned slate quarry 3,500 ft. from the center of, and 250 ft. above, our village can be fitted up as a reservoir of 3,000,000 galls. capacity. Probably I will make further surveys soon, as the project is a promising one. L. F. BILLINGER, C. E.

CANTON, Mass., June 1, 1888.

EDITOR ENGINEERING NEWS:—The town has a charter from the State authorizing it to issue bonds to the amount of $150,000, with which to build water-works. The bonds will bear 4 per cent. interest and run from 1 to 30 years. Our population is about 5,000. Water will be taken from Springdale and Henry springs and pumped to a stand-pipe. Hydrants will be used for fire protection, with a pressure varying from 48 to 96 lbs. WM. WHEELER is our Engineer. Contracts have been let to the McNeal Pipe & Foundry Co., Burlington, N. J., and to C. H. Engler for pipe laying.

F. M. AMES, *Chairman Water-Works Board.*

KITTANING, Pa., May 28, 1888.

EDITOR ENGINEERING NEWS:—We propose to let contracts about July 1 for water-works to supply this place. R. H. WILSON is Engineer. Water will be pumped to a reservoir from the Monongahela river. The hydrant pressure will be 90 lbs. Works will cost about $87,000, and it is intended to have them completed in a year. Population, 4,800.

Besides the above, we will complete in July a plant at Washington, Pa., costing $150,000, and with impounding reservoirs of 13,000,000 galls., and a distributing reservoir of 2,500,000 galls. capacity. We have a contract with the city for 5 hydrants.

Our company is composed of four persons who form a syndicate controlling the water companies supplying six places. GEO. H. FOX,

Secretary, Kittaning Consolidated Water Cos.

GAINESVILLE, Ga., May 22, 1888.

EDITOR ENGINEERING NEWS:—The Council is now investigating the matter of establishing water-works. We have water-power from the cotton factory but with piping and tower on as cheap a scale as possible. Can you give low prices for water-works as above stated?

WARREN H. CAMPBELL, *Clerk of Council.*

TROY, Tenn., May 31, 1888.

EDITOR ENGINEERING NEWS:—I would be pleased to have some information from water-works contractors upon the subject of complete water-works for a town of about 1,500 inhabitants. The building of the water-works is contingent upon their cost and the conditions under which the contractors would build them. Would be obliged to you if you will kindly refer the matter to some one who will give us full information in detail, as to the cost of various systems, JNO. B. INMAN.

MARSHALL, Tex., May 31, 1888.

EDITOR ENGINEERING NEWS:—We have closed a contract with E. SUTPHIN, of Kansas, for a complete system of water-works. He is to begin work June 1 and complete the works Dec. 1. Water to be supplied by the Wagner steamed well system; 6 miles of pipe. Cost, $62,-200 cash. Water guaranteed.

JAS. H. CARTER, *Mayor.*

CHADRON, Neb., June 2, 1888.

EDITOR ENGINEERING NEWS:—Contracts will be let by the city June 26, for water-works to supply this place. Our population is 2,000, and is now supplied with water from springs 1½ miles distant, the water being hauled in wagons. The new supply will be from Chadron creek, three miles distant, and will be pumped to a reservoir. Hydrants will be used for fire protection. The works will probably cost $35,000. ROBT. HOOD is chairman of the Water Board and A. A. RICHARDSON, Lincoln, Neb., consulting engineer.

P. M. PRITCHARD, *Engineer-in-Charge.*

We have received for use in the MANUAL 18 reports from Mr. S. R. BULLOCK, covering both the completed works which he owns and controls and those which he is now building. These works are scattered through 10 States, and the cities which they supply have a combined estimated population of more than 250,000. He will finish this year works at Chester, Pa.; Defiance, O.; Jeffersonville, Ill.; Stevens Point, Wis.; Mobile, Ala., and Vicksburg, Miss.

Annual Reports.

Newport, Ky.—The Trustees of the Water-Works have submitted their report for 1888. The works are in good condition, but in December the water had a bad taste and odor. It is recommended that necessary repairs be made to the reservoir; the main embankment broke and slipped some years ago and there can now only be 16 ft. of water kept in the reservoir instead of the intended 30 ft. The receipts for 1888 are estimated at $35,800; and expenditures for extensions, repairs, operating, etc., $37,500. During the year 1.29 miles of 2 to 12 in. pipe, and 230 new connections were added. There are now 26.57 miles of 2 to 30-in. pipe. More flushing valves are recommended. B. R. MORTON is Superintendent.

Lowell, Mass.—The 15th annual report of the Water Board has been issued, being for the year 1887. During the year contracts for cast-iron pipe were let to the Donaldson Iron Co., of Emaus, Pa., for 10 tons of 4-in., 100 tons of 6 in. and 10 tons of 8-in. pipe, at $34.50 per net ton, and to the Gloucester Iron Co., of Gloucester, N. J., for 150 tons of 12-in. and 10 tons of 8-in. at $35 per gross ton. The total consumption of water was 1,576,-495,007 galls., of which 352,338,750 galls. were metered. The supply is reasonably pure, but monthly analyses show an increasing impurity and means are recommended to provide for a new supply or for a more thorough system of filtration, aeration and settling basins. The works were built in 1870-72 and are owned by the city. The supply is pumped from the Merrimack river by one Morris pump and one Worthington pump of 5,-000,000 galls. daily capacity each. The estimated population supplied is 68,000. There are 438,351 ft. of 4 to 30-in. cast-iron pipe, of which 9,116 ft. were added during the year; 779 hydrants, 552 stop gates, 17 blow off gates and 26 fire service gates. The range of pressure is 50 to 60 lbs. There are 54 miles 2,654 ft. of ¾ to 3-in. lead and wrought-iron service pipes; 7,449 service taps and 1,530 meters. Tables are given of engine performance. ROBERT J. THOMAS, Superintendent.

Wausau, Wis.—The Water Commissioners have issued their report for 1887, being the second annual report. The original cost of the works, including pipes, machinery, building, real estate and supply well was $115,175.11. The expenses for construction, including services were $13,512.47 for 1886, and $3,339.09 for 1887, making the total cost of the works to the end of 1887, $132,126.67. There are about 14¼ miles of distribution pipe, 109 fire hydrants, 78 valves and 414 taps. During the winter considerable trouble was caused by the freezing of water in the dead ends, and in consequence all the dead ends are now being done away with. The total amount of water pumped during the year was 158,856,799 galls. A system of sewerage is recommended. The report contains the ordinances, rules and regulations, and rates in connection with the water supply. The contract for construction was awarded in January, 1885, to the Holly Mfg. Co., of Lockport, N. Y., for $110,500. The supply is pumped from a supply well directly into the mains by two pairs of Gaskill compound pumping engines of 3,000,000 galls. daily capacity each, capable of throwing 10 fire streams 100 ft. high through 50 ft. of hose. PHILIP RINGLE is Superintendent.

New Brunswick, N. J.—The Water Commissioners have issued their report for 1887, being the 15th annual report. The supply of water in the reservoirs has been abundant and the quality is very good. The water is obtained from a surface stream. Some of the cement-lined pipes which were laid more than 20 years ago are being replaced. During the year 5,820. ft. of pipe, 3 hydrants and 18 valves were added, and in making extensions dead ends are avoided as much as possible. There are now 132,032 ft. of 2 to 16 in. pipe, 176 hydrants, 279 gates, 80 meters and 1802 taps. The total consumption was 395,297,203 galls. A. J. JONES is Superintendent.

RECORD OF NEW WATER-WORKS CONSTRUCTION.

(*Specially Communicated.*)

(CONTINUED FROM PAGE 460).

Drownville, R. I.—The works were commenced in July, 1887, and completed in November, 1887. The trenching and pipe laying was done by day's work. The pumping machinery and tank were furnished by Mast, Foos & Co., of Boston, Mass., and the pipe and specials by Ayrault Bros. & Co., of Tonawanda, N. Y. The supply is taken from wells and pumped by windmill pumps of 8,000 galls. daily capacity to a tank 16 ft. × 24 ft., with a capacity of 52,000 galls. There are 2 miles of Wyckoff pipe, 25 taps and 7 meters; Wyckoff pipe is used for the services. Average daily consumption, 2,000 galls. Ordinary pressure, 40 lbs. Cost of works, $6,500; debt, $2,000. The revenue from consumers is estimated at $300. The works are owned by the Drownville Water Co.: President, DAVID A. WALDRON; Treasurer, GEORGE T. BAKER; Secretary and Superintendent, C. F. ANTHONY. Capital stock, $4,500. The present population is estimated at 300.

Bath, N. Y.—The works were commenced April 15, 1887, and completed Sept. 20, 1887. They were designed and built by Bassett Bros., of Buffalo, N. Y. The pipe was furnished by the Buffalo Cast Iron Pipe Co.; the pumping machinery by the Geo. F. Blake Mfg. Co., of Boston, and the valves and hydrants by the Ludlow Valve Co., of Troy, N. Y. The stand-pipe was built by Farrar & Traft, of Buffalo. The supply is drawn from wells and springs and pumped to a stand-pipe of 306,000 galls. capacity by a pump of 1,500,000 galls. daily capacity. There are 7 miles of 6, 8 and 10-in. mains, 71 hydrants, 39 taps and 5 meters. The mains are of cast-iron and the service pipe of galvanized wrought-iron. Ordinary pressure, 80 lbs.; fire pressure, 125 lbs; Cost of works, $100,000; debt, $60,000; rate of interest, 6 per cent. Annual revenue from city, $2,400 for hydrant rental. The works are owned by the Bath Water-Works Co.; President, F. A. HINDE; Secretary, E. M. BASSETT; Treasurer, S. F. BAGG; Superintendent, CHAS. VAN WIE. Capital stock, $72,000. The present population is about 5,000.

East Tamas, Mich.—The works were commenced in July, 1887, and completed in February, 1888. They were designed by MAX WALKER, and A. L. HOLMES, of Grand Haven, Mich., was Consulting Engineer. They were built by the Michigan Pipe Co., of Bay City, Mich. The supply is taken from Lake Huron and pumped direct by a Gaskill pumping engine of 1,500,000 galls. daily capacity, with steel boilers. There are 7 miles of wood pipe, and 64 hydrants. Average daily consumption, 200,000 galls. Ordinary pressure, 30 lbs.; fire pressure, 60 to 90 lbs. Cost of works, $28,000; debt, $28,000; rate of interest, 6 per cent. The works are owned by the city, which has issued bonds for $28,000. President, T. EMERY; Secretary, W. E. MOWREY; Superintendent, SOLON SAWYER. The estimated population is 3,000. The price paid for trenching and pipe laying was 10 cts. per ft.

TO BE CONTINUED.